Volume 7 September 1961 No. 7

INTERPLANETARY EXPLORATIONS — A SYMPOSIUM
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Science and Engineering in Air and Space

Canadian Aeronautical Journal

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INTERPLANETARY EXPLORATIONS

A SYMPOSIUM

sponsored jointly by

CANADIAN AERONAUTICAL INSTITUTE: ASTRONAUTICS SECTION

CANADIAN ASTRONAUTICAL SOCIETY

UNIVERSITY OF TORONTO, INSTITUTE OF AEROPHYSICS

and the DAVID DUNLAP OBSERVATORY

to be held at the

UNIVERSITY OF TORONTO, INSTITUTE OF AEROPHYSICS

on the 26th and 27th October, 1961

The full programme is given on page 284 of this issue.

REGISTRATION

At the UTIA, beginning at 8.30 a.m., 26th October. Members of the sponsoring organizations $3.00: Non-members $5.00.

Students wishing to attend should notify Professor E. D. Poppleton, Institute of Aerophysics, University of Toronto (Phone MElrose 5-0310) before the 25th October and apply for exemption from registration fee.

ACCOMMODATION

A block of rooms is being held in the Westbury Hotel, 475 Yonge St., Toronto 5; reservations should be made before the 10th October. Bus transportation between the hotel and the UTIA will be provided.

LUNCHEON

Luncheon on both days will be held in the De Havilland Staff Dining Room at 1.00 p.m. Price $2.25 including tax and gratuities.

DINNER

A Dinner, preceded by a Reception starting at 6.00 p.m., will be held on the 26th October in the De Havilland Staff Dining Room. Dress informal. Ladies are welcome. Price $4.50 including tax and gratuities.

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The attached slip should be used when ordering tickets for the Luncheons and the Dinner. Cheques and money orders should be made payable to the Canadain Aeronautical Institute.

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Mail to: Mr. A. Barnes, Special Products Division,
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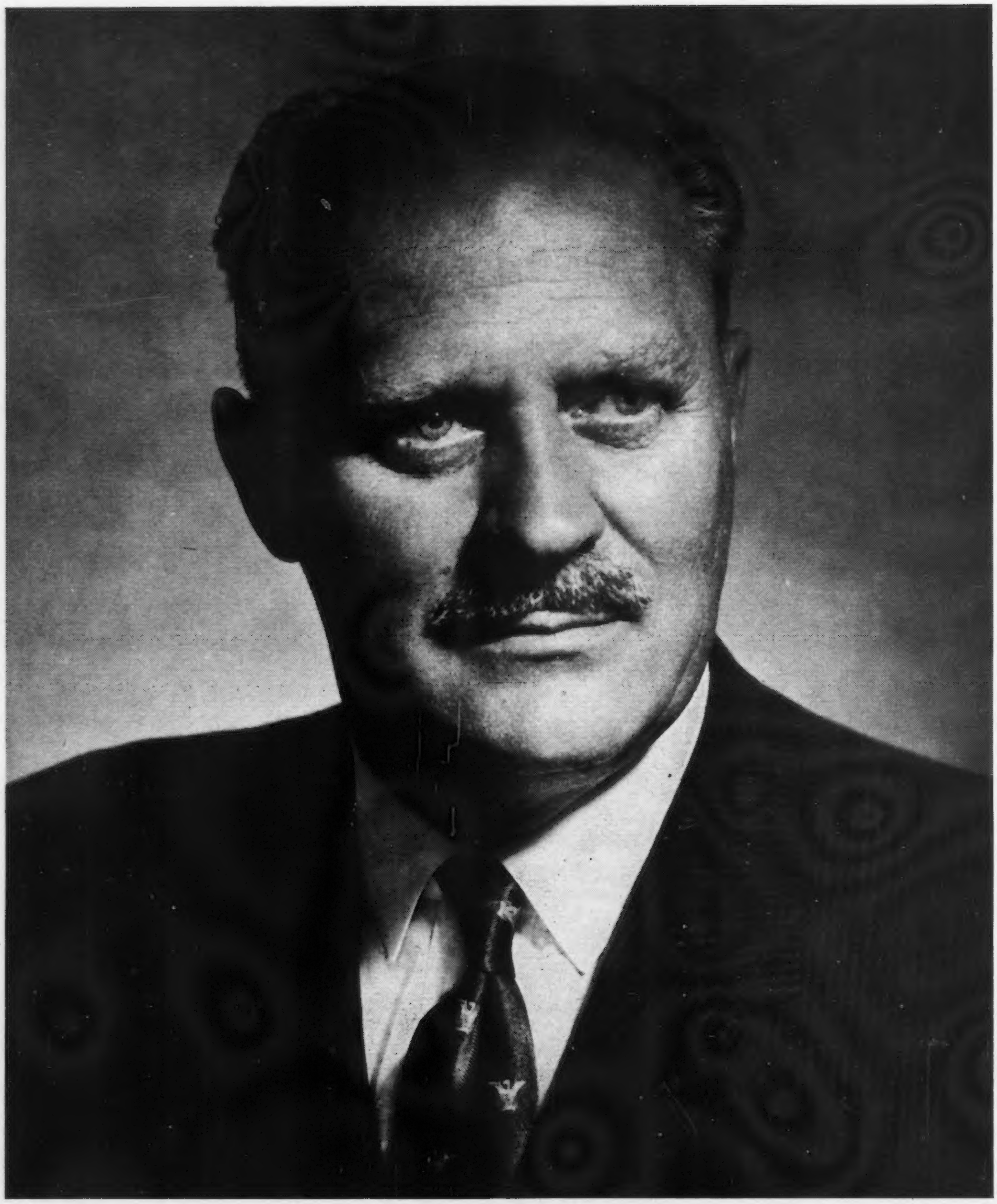
THE PRESIDENT 1961-62



EDITORIAL

THE PRESIDENT'S MESSAGE

THERE have been four successful manned rocket flights to date; all were remarkable, but the most recent was indeed a spectacular performance. As in all achievements of man in the past, our attention was focussed in each case on the central figure, the man who made the flight. By his personal courage and ability, each symbolized the efforts of all those associated with his adventure.

The thoughtful scientist, engineer or technician will realize readily the parts played by their colleagues in assuring these successes, and these roles have been generously acknowledged. Whilst this is vaguely appreciated by the general public, little attention is given to the contribution made by universal science and technology, the aggregate of knowledge available to all resulting from the exchange of man with man of his ideas and experiences, his crafts and his goods. By far the most significant exchanges are by the written word and the spoken word and they are made freely without let or hindrance; the bar is drawn only at a relatively small amount of information which is rightly reserved in the interests of national security.

Today the universal pool of scientific and engineering knowledge grows with a speed and accuracy compounded by our rapid advances in the technologies of communication and transportation.

Technical libraries are increasing throughout the world and the bulk of their material comes from relatively few countries. It is important to note that in these countries there are, in every case, well organized and active societies and institutions, which play a major role in stimulating and supporting science and technology. Canada is one of these countries and her contribution is significant, whether it is made directly or through institutions in other countries to which Canadians belong or contribute. In many institutions, staffs of trained technical translators – soon to be assisted by electronic translating machines – add to the value of new material from other countries. With the aid of efficient librarians, the scientist and the engineer are kept up to date on current developments.

Nor should the value of the spoken word be underrated. The easy use of radio, television and telephone to exchange *information* is taken for granted. The exchange of *ideas* and their subsequent development are fostered best by man's traditional means of communication – personal and group discussions. The value of the well-planned meeting, as exemplified by the Duke of Edinburgh's Commonwealth Study Conference and the Couchiching Conference, applies as well to the lesser known national and international scientific and technical meetings which are fostered by organizations such as ours. The stimulus of discussion generates and challenges ideas in a manner difficult for the written treatise to emulate. It should be noted here that the Institute has always maintained that our meetings improve by less formal presentations and more discussion. Air transportation today enables an economy of time which makes personal and group discussion by people from the world over a part of our way of living.

Can we, as Canadians, continue to contribute usefully to the growing pool of science and technology side by side with the giants who preponderate? In the fields of political and economic science doubts are being voiced on the wisdom of invoking nationalism for its own sake, and it is becoming commonplace to assert that ultra-nationalism carries too high a price.

The physical sciences are in no such quandary. The scientist needs no alliances; he exists as a scientist by his inherent intelligence and ability and he prospers by his own initiative, and the exchange of ideas and experience. The achievements of Canadian scientists are as national as those in other countries. Their ac-

complishments are increasing to the credit of themselves and our country.

The applied sciences, and particularly those relating to aeronautics, are beginning to reassert themselves after a disquieting trend to overdependence on other countries. Our engineers and technicians are amongst the most resourceful in the world and surely they can do much to invigorate the aviation economy to which they belong; for anything, great or small, is worth doing for itself and, by being done, leads on to greater things.

Canada's human and natural resources are such that, in proportion to much of the world today, our contribution to the science and technology of aeronautics and space can and should be greater than it now is. All endeavours to this end, whether public or private, group or individual, must receive the strongest support from each and every one of us in this Institute.

AIR COMMODORE W. P. GOUIN, RCAF
President 1961-62

THE END OF AN ERA

The Hon. J. A. D. McCurdy

AIR Commodore the Honourable J. A. D. McCurdy is dead. He died on Sunday, the 25th June, and a funeral service, with full military honours, was held in Montreal on the following Wednesday. Later his ashes were buried at Baddeck, and there was a short twilight service at the Monument erected by the Institute in 1959 to mark the 50th Anniversary of his historic flight.

For 52 years he had played an active part in Canadian aviation, which started with his flight at Baddeck and has experienced its full measure of glories and frustrations ever since. He was active almost to the end and was awarded the McKee Trophy last year for his tremendous exertions, on behalf of all of us, during the year-long celebrations of 1959. At the unveiling of the Monument, Dr. G. N. Patterson, President of the Institute, remarked "The most wonderful thing about this Golden Anniversary is that we have Mr. McCurdy here to help us celebrate it".

He is here no more and his death provides a fitting point in history to close the first volume of aeronautical engineering in Canada. The second volume will see Canadian science and engineering extending beyond the atmosphere, and it is perhaps no mere coincidence that, simultaneously with McCurdy's death, the Institute is intensifying and emphasizing its interest in the space sciences.

Man's penetration into space, like the flights of the pioneers half a century ago, has caught the imagination. Whatever our personal views, whether we look forward to eventual colonization of the planets or whether we recognize near space as already a valuable field for aeronautical research, we cannot ignore the challenge; the Institute is involved in space; flight "beyond the atmosphere of the earth" is written into our terms of reference.

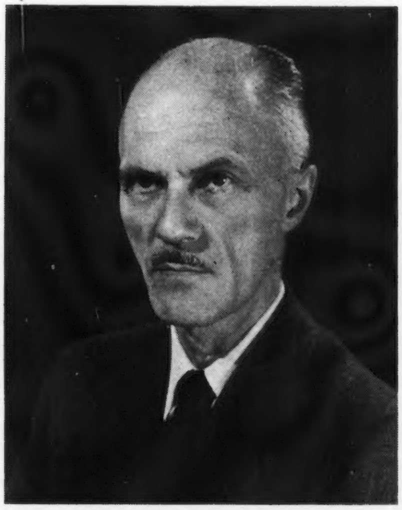
But with our eyes fascinated by these new horizons, we must not let ourselves be distracted from the problems that aviation still presents in the foreground of our vision. If we think that aeronautics – in the air – is passé, we delude ourselves. Man will continue to live upon the earth and to go to and fro in it; and he will have to use air transport to do so. Perhaps the curve will flatten out, as it has done with surface transport, and the advances in aviation may tend to become less spectacular than they have been; but there are still plenty of advances to be made – quiet and economical VTOL, all weather capability and blind landing, effective air traffic control and, that unheeded waif, the *light* supersonic transport.

We must proclaim and develop our interests in space but we must not neglect our responsibilities in the air. This is the end of an era. The future with its limitless possibilities lies before us. But many of the problems indirectly posed to us by the Aerial Experiment Association in 1909 are still unsolved.

THE WORLD'S MOST DANGEROUS AIRLINE†

by B. S. Shenstone*, F.C.A.I.

British European Airways



Mr. B. S. Shenstone

ONLY four weeks ago I spent five solid days in Montreal listening to the IATA Supersonic Air Transport Symposium under the chairmanship of Jack Dyment. This Symposium was set up at the request of the Executive Committee of IATA so that all the advantages, disadvantages and problems of supersonic air transports could be brought into the open.

In spite of the natural tendency for designers to keep their own designs to themselves, a great deal did come into the open, and all possible points of view were well aired. In addition, a number of impossible points of view were also proclaimed.

The airlines did not call this Symposium into being because they were mad keen to get into the supersonic transport business. It was indeed rather the opposite. During the last few years an enormous amount of propaganda has been floating about on the necessity for airlines to buy supersonic transports. The inadequately based confidence expressed by some manufacturers and opposite views by others made some public expression of views very necessary.

I do not know what impression was gathered by manufacturers who were at the Conference, nor can I speak for other airlines. I rather expect that sufficiently wide views were expressed so that every manufacturer still feels that his idea is the best, because the manufacturer's views are inherently rather subjective. In other words, the manufacturer looks for confirmation for what he thinks is right and he always finds it. This is the fate of all enthusiasts and certainly to sell a supersonic aircraft requires incalculable enthusiasm and subjectivity and a complete lack of conservatism.

What the airlines thought of the symposium may vary just as widely as what the manufacturers thought, but I think everybody will have agreed that there are many more problems than solutions. I shall make no attempt at this moment even to list the problems, but they are serious, such as how not to fry the passengers or how to prevent non-passengers from going deaf. In my own opinion, the difficulties now seem greater than they were before the Symposium took place, and I am rather glad that my own airline, being a short-haul airline, will not have any interest in supersonic airliners for many, many years to come. But there may be airlines, or even just one airline, which may be weighing certain pros and cons and wondering whether it should be the very first to go supersonic.

At the moment, it does not look as if aircraft in the Mach 3 category could be available for airline use before 1975 from the technical point of view. If somebody wants them by then, they may be thinking about it now. The question is: "Should they be thinking about it now?" Some people say that nobody should be thinking about it now and others say that there should *never* be supersonic transports. The word "never" in aviation is a stupid word, as any of us who have used it know. Supersonic transport will certainly come and some day will be used, although possibly not enjoyed, by the public. But is it right and proper from the public point of view that consideration should be given to the possible use of a machine in fifteen years from now which is 3½ times as fast as those machines we are now flying?

It took the aircraft industry twenty years to learn to fly 3½ times as fast as the DC-3, and in that progression there were several steps. The increase in miles per hour over those twenty years was about 430 mph. The present suggestion is that in fifteen years we should, without intermediate steps, increase our speed 3½ times, which in this case does not amount to 430 mph, but to about 1500 mph increase. That is why some people are wondering whether this is a proper or sensible thing to consider.

†Dinner address read at the Annual General Meeting of the C.A.I. in Toronto on the 25th May, 1961.
*Chief Engineer

Quite apart from some of the minor problems, the likelihood of running into difficulties of a technical and operational nature with such a sudden increase in transport speed needs most careful consideration. I think it should never be forgotten that even the moderate increase from the last piston-engine machines to the first jets has caused a great number of technical problems, and I think I can say clearly that every jet flying at more than 500 mph has had major teething troubles ranging from the disastrous to the merely expensive. Three major manufacturing firms have faced or are facing serious financial losses and a number of airlines using their products have lost a great deal of money. Many of these airlines were rather forced into buying jets before they were financially capable of doing so, so that even had they bought the jets which had the least teething troubles, they would still have been financially embarrassed. Those that were unlucky enough to buy the more faulty aircraft are certainly badly off. As we all know, it all started when one large airline bought jets in April 1955. Thereupon many others were forced to buy them.

Although jets are now demanded by the public and in many cases are bringing in excellent incomes, there are still a number of airlines in the world which are suffering from the cost of jets and others which are just climbing back into the black, and all this has happened for an increase of only 200 mph between one machine and the next. So if anybody is now thinking seriously of pulling a fast one with a view to announcing within the next few years that they will buy a Mach 3 transport, they may be storing up danger in two ways. If they meet serious technical operational difficulties, it will cost them a lot of money, but a very large airline might consider it a fair risk because of the advantage gained over the competitors. Even if the time may be ripe for supersonics technically, it may not be ripe financially. The difficulty is that although such an airline might find it just possible financially to commit itself to supersonic airliners, it would at that moment become a danger to many other smaller and financially less durable airlines. History shows that they would have to take a chance which they could not afford.

The result would inevitably be combinations of many smaller airlines into units sufficiently large to be competitive and financially sound. In the international sphere this would mean that many nationally "chosen instruments" would disappear or become heavily subsidized. Alternatively, several might be forced into combination and such combinations could exert complex and difficult travel restrictions of a type hitherto unknown. This could constitute a real danger to the public who would have to bear not only these limitations but probably higher costs in fares, resulting from this scramble. You see, this is not the usual kind of danger to lives of passengers, but to the lives of airlines themselves and danger to service to the public — that is, to you.

I know that going one better than anybody else is always highly attractive, even to airline presidents, but one of the great dangers is that airline presidents will be so fascinated with the marvels of Mr. Mach, and in spite of the advice of their stick-in-the-mud engineers, who are, of course, always right, they will not be able to resist the temporary aura which will surround him who may be destined to operate the world's most dangerous airline.

McCURDY AWARD

The McCurdy Award will be presented at the Annual General Meeting, which will be held on the 14th and 15th June, 1962.

It is the premier award of the Institute and is presented annually

For outstanding achievement in the art, science and engineering relating to the aeronautics.

The recipient shall be a person who, while a resident of Canada during recent years, has made a significant personal contribution in any field of endeavour, including, but not limited to, engineering, science, manufacturing, aircraft operations or management.

NOMINATIONS ARE INVITED

Each nomination should include

(a) The name and affiliation of the nominee,
(b) A citation of the particular achievement for which the nomination is being put forward,
(c) Confirmation that the nominee was a resident of Canada at the time of the achievement, and
(d) The name of the nominator.

The nominee need not be a member of the C.A.I.

Nominations should be in the hands of the Secretary not later than the 31st October, on which date they will be handed over to the Senior Awards Committee.

SOME THOUGHTS ON A NAVIGATION SYSTEM FOR A MACH 2-3 TRANSPORT†

by W/C K. R. Greenaway*, F.C.A.I.

Royal Canadian Air Force

THE introduction of jet transport aircraft has brought about much speculation as to how long it will be before supersonic transports are flying the air routes of the world. Most of the speculation has to do with the economics of operation, for technical discussions indicate that aeronautical engineers have a fairly common idea of the airframe design and powerplant requirements for the supersonic transport aircraft. Practically nothing, however, has been said about the flight control and navigation system for these aircraft. Therefore, I believe, it is quite appropriate for us to give some thought at this time to the navigation system.

As an introduction I plan to review and examine the navigation situation of the last ten years. From this examination you will see that the concept and basic characteristics of the navigation system for supersonic transports can be clearly outlined.

Improvements in airframe and powerplant design for transport aircraft have always outstripped developments in the navigation field. This is to be expected as the primary interest has always been on improved performance and flight safety. Many so-called integrated flight systems have appeared within the last few years and the work load on the pilot of actually flying the aircraft has been decreased by the introduction of greatly improved auto control aids. All these have improved the in-flight handling of the aircraft; but the development of navigation aids and systems for efficient guidance and control of the aircraft has continued to lag far behind.

IMPACT OF LONG RANGE AIRCRAFT

In the mid 50's many changes in the relatively stable global route patterns were brought about by the introduction of long range transport aircraft. Many direct and more economical routes appeared. As these diversified routes were added to the already complex pattern there became an urgent requirement for a single global navigation facility capable of providing area coverage for all latitudes, rather than for any particular route pattern. Ground based aids for en route navigation, such as Loran and Consol, were found only along the older and more congested air routes and, even then, large over-water areas were inadequately covered for precise navigation. A number of aids were proposed but, as no one particular aid stood out above the others, no common facility was adopted. Hence, aircrews were faced with the task of navigating aircraft whose performance had outstripped development of a precise en route global navigation facility. To further complicate the picture, short range aids, or "terminal area aids" as they are frequently called, were not standardized, and differed among many countries and regions. There was no general agreement on a common system.

The lack of "area coverage" aids forced the operators of long range international transports to look for a self-contained navigation system which would provide the flexibility needed to fly efficiently the diversified and more economical flight paths. Fortunately for the civil operator, the air forces had an even greater requirement for flexibility in air operations and had been sponsoring the development of self-contained en route aids. The leader in the field was doppler radar. In response to demands from aircraft manufacturers and operators, the military-developed doppler radar was made available for commercial use in June 1957. Doppler is capable of measuring the drift to better than 0.5° and ground speed to better than 1%. With its introduction, crews of civilian transport aircraft had available for the first time, regardless of the route flown, continuous presentation of ground speed and drift, and to an accuracy heretofore unattainable.

IMPACT OF HIGH SPEED JET TRANSPORTS

Now let us look at the effect that high speed jets had on the navigation situation. All the navigation problems of the long range reciprocating engine transports were inherited by the jets and a few more were added because of the increase in speed.

Until the introduction of jets, very few transport aircraft were even equipped with elementary Dead Reckoning computers, such as the air position indicator, let alone with doppler radar. The navigator collected the desired navigation information from various unrelated aids and sources, maintained a manual air or track plot, passed heading alterations to the pilot and revised times of arrival. The human computer and manual servo loop concept was quite satisfactory for slow flying transports, but left much to be desired when applied to the navigation of high speed aircraft. Therefore, it was obvious even some

†Paper read at a meeting of the Ottawa Branch of the C.A.I. on the 15th February, 1961.

*Officer Commanding – Central Navigation School

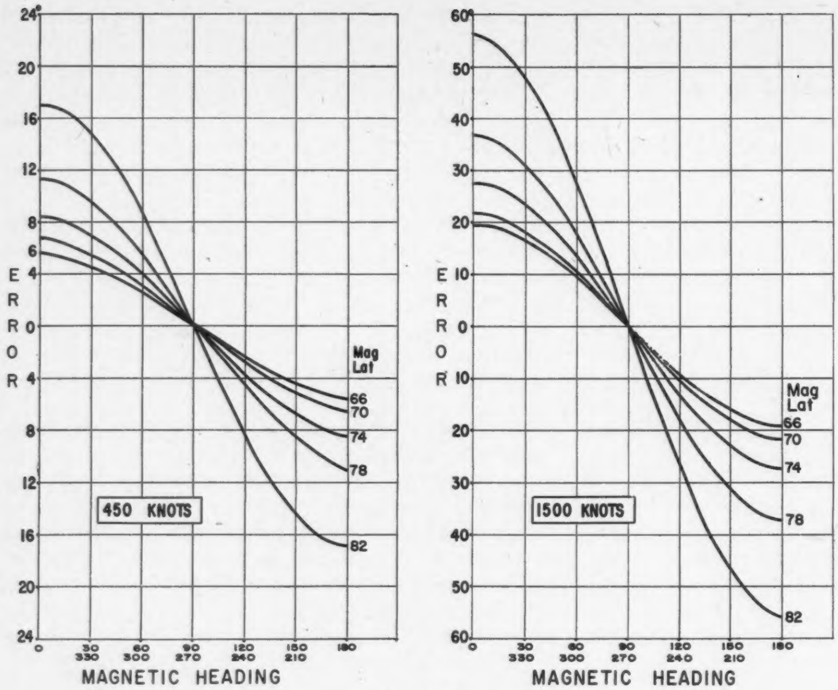


Figure 1

Turning errors in aircraft heading induced by the flux valve of a gyro magnetic compass system with a slaving rate of 6°/min when flying at 450 and 1500 kts

years ago that the basic DR system for jet transports would be an automatic DR computer receiving heading inputs from the compass system, and drift and groundspeed from the doppler radar. In actual fact this has occurred and, in jet navigation, the automatic position computer has replaced the manual plot. Now the navigator has only to concentrate on checking the DR position with various fixing aids, monitoring the heading, computing the arrival time and maintaining fuel consumption records.

Automatic computers can be designed to indicate position in a number of ways, such as latitude and longitude, distance and bearing from base or to destination, as x and y co-ordinates on a rectangular grid, or as distance to go and miles off the desired track. Of the above systems the Along and Across Track Computer appears to be favoured today by transport operators. This computer, in conjunction with doppler radar, underwent trials on global routes during the late 1950's and is now being installed in most jet transports.

The Along and Across Track Computer was designed as a simple means of displaying doppler information but, although it appears to be less cumbersome than latitude and longitude computers, when used with current grid reference systems it lacks flexibility and other features desired of a computer for supersonic aircraft. It is not compatible with great circle referencing systems because of its plane triangle solution and this is probably its greatest limiting factor when considering it for future navigation systems.

The next step in transport aircraft navigation was to close the loop between the navigation system and the aircraft control surfaces by taking the across track error output from the Along and Across Track Computer and feeding it as a correction signal to the auto control unit. Thus, the aircraft would automatically fly along the desired track. Scandinavian Airlines System pioneered this technique and have been using it for several years on their polar routes where it was first tested. This integration of the DR navigation system with the flight controls has ushered in the era of the automatic navigator, according to many enthusiasts of automatic flight. While this may appear to be so, a close look at some of the components of this system in relation to the operational environment will reveal that several changes in design concept are required before this situation truly exists.

Heading component

The accurate measurement of ground speed and drift by the doppler sensor gives a false impression of the accuracy obtainable from the automatic DR system. The track of the aircraft can still only be determined to the accuracy of the heading reference system.

The magnetic compass has always been the primary directional aid in transport aircraft, except of course when operating near the magnetic poles. The modern gyro magnetic compass, although a marked improvement over the older compasses, is, however, subject to the following types of errors, many of which become significant at high speeds.

(*a*) *Turning error*

Any movement which tilts the pendulously mounted flux valve out of the horizontal about its N-S axis will cause it to sense a false heading change induced by the vertical component of the earth's magnetic field. This error varies with the magnetic heading and increases with an increase in magnetic latitude or aircraft speed. The error is maximum when the magnetic heading is near 360°. An approximation of this type of heading error is given by the following formula:

$E_h = Vw/g$ (tan mag lat) (cos mag track)

where E_h is the amount of heading error in degrees induced by the canted flux valve,

V = ground speed of aircraft in feet per second

w = magnetic slaving rate in degrees per second

g = ft/sec^2

Figure 1 shows the magnitude of the flux valve error for 450 and 1500 kts at several magnetic lati-

tudes for a gyro magnetic compass system with a slaving rate of 6° per minute. This error is, of course, modified by other characteristics of the compass system. On northerly headings the erroneous signal causes the directional gyro to precess in a direction such that aircraft control signals will increase the rate of turn. On southerly headings the sign of the erroneous signal is reversed and the stability of the heading loop is increased.

(*b*) *Acceleration error*

If an aircraft is on an E-W magnetic heading any changes in speed, such as those brought about by "altitude hunting", will tilt the flux valve out of the horizontal about its N-S axis to give the same maximum flux valve error as a heading oscillation on a 360° magnetic heading.

(*c*) *Coriolis effect*

Coriolis acceleration will also tilt the pendulously mounted flux valve out of the vertical. At high speeds and high latitudes the error must be considered. The coriolis error is westerly on northerly headings and easterly on southerly headings. A close approximation of the error in heading can be found by using the formula: E = (tilt × tan mag lat × cos magnetic track) where tilt is the flux valve tilt due to coriolis. The amount of tilt can be found by referring to the coriolis tables for bubble sextants. An indication of the size of the error is given in Figure 2.

(*d*) *Variation*

The variation shown on navigation charts may contain large errors. The isogonals are plotted using average values obtained from ground surveys and discrepancies of several degrees can be expected in remote areas, on intercontinental routes and at high altitudes. In addition, the variation fluctuates over short time periods.

(*e*) *Averaging error*

The practice of using the average values of variation between points to convert magnetic heading to true heading results in an error in the aircraft heading which is reflected in the output of the automatic position indicator. At high speeds the change in variation may be so rapid that constant resetting of the variation control will be required if this type of error is to be kept within tolerable limits.

(*f*) *Deviation*

Short term changes in the density and inclination of the magnetic field, caused by natural phenomena, may result in compass errors of several degrees. This is particularly true considering the large changes in magnetic latitude that may be encountered by aircraft flying global routes.

Most transport operators are fully aware of the shortcomings of the magnetic reference and have installed gyro compass systems, which make magnetic slaving of the directional gyro optional during the en route phase of the flight. It is, therefore, common practice when navigating jet transports equipped with doppler fed automatic position indicators to use the directional gyro to maintain the desired heading during the en route phase of the flight regardless of the latitude. Most of the directional gyros in use today in jet transports have real wander rates of not more than 1°/hr, and experience has shown that slaving these gyros to the magnetic field at almost any latitude deteriorates their performance and results in a less accurate and stable heading than if they were "free".

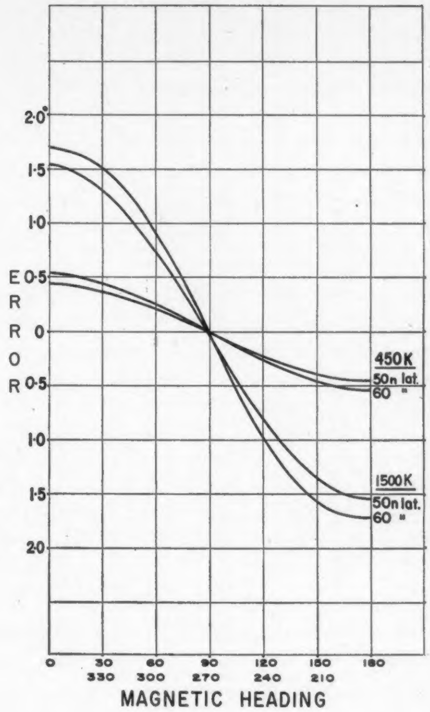


Figure 2

Errors in the magnetic heading caused by coriolis for speeds of 450 and 1500 kts when flying at a magnetic latitude of 72°N

Magnetic compass systems are not only inadequate for use with automatic DR systems at current jet speeds, but they are completely unacceptable for navigation at supersonic speeds. An indication of magnetic heading will be required for the pilot, however, since Air Traffic Control and terminal area aids will still be referenced to magnetic north even in the era of the supersonic transport.

Directional datum

The relegation of the magnetic reference to a standby role, and the use of the gyro as the primary directional aid in high speed aircraft, has introduced to mid latitudes the grid techniques heretofore only associated with polar flying. For many routes, the polar grid techniques have been modified by selecting a more convenient meridian than Greenwich for the directional datum. The change to gyro reference is here to stay, but the choice of a reference datum and a steering technique depends upon the degree of automaticity built into the integrated navigation system.

The reference datum and steering technique is associated with the characteristics of the directional gyro and its relation to the geographic reference system. The observed deviation of a directional gyro that

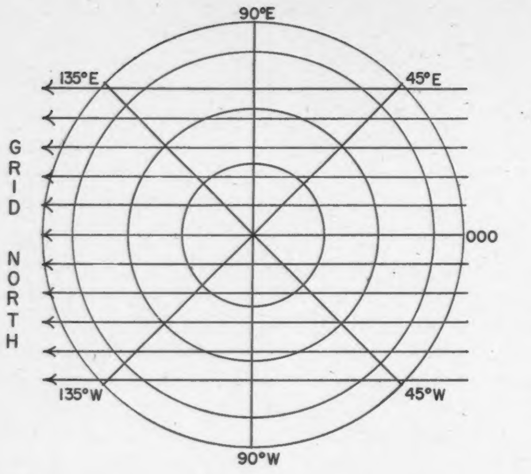


Figure 3
The grid system in use for many years in the polar regions to overcome the extreme convergency of the meridians

has been aligned with a fixed reference on the earth is normally called wander, and results from three types of movement:

(*a*) *Apparent wander due to earth rotation*

Since the earth rotates from east to west and the axis of the gyro remains fixed in space there will be an apparent decrease in the directional gyro reading even when it remains at one point on the earth. The amount of apparent wander is equal to 15.04° × sin latitude/hr. Early directional gyros were equipped with balancing screws to correct for apparent wander due to earth rotation for only one particular latitude. The gyros in the newer type compass systems are equipped with latitude precession correctors which enable the navigator to compensate for earth rotation effect for any latitude just by setting the desired latitude on the scale of the corrector.

(*b*) *Apparent wander due to change of longitude*

This type of wander is caused by transporting the gyro across the converging meridians and is referred to as transport wander. Assuming that compensation has been made for earth rotation, a gyro pointing at a fixed reference in space will appear to wander at a rate equal to the convergency of the meridians it is crossing, i.e. at a rate equal to change of longitude × sin latitude. Transport wander can be eliminated by using a grid system based on the actual convergency of the meridians. However, grid systems in current use are based on map convergency (change of longitude × the cone constant of the chart) and do not completely eliminate transport wander. The remaining amount of transport wander is directly related to the difference between the actual convergency of the meridians and map convergency or, in other words, the difference between the great circle track and the map track. The approximate amount of residual transport wander can be calculated by the following formula: change of longitude × (sine mid lat — cone constant).

(*c*) *Real wander*

Friction and mass unbalance as well as many other factors produce torques which cause the gyro axis to wander from a fixed reference. In recent years real wander has been reduced considerably and directional gyros now coming into commercial use have real wander rates of about 1°/hr.

With provision to compensate for the effect of earth rotation and with real wander reduced to 1°/hr, navigators are now primarily concerned with the choice of a reference datum and a grid technique. Most of the transport wander can be eliminated by using a grid system, basically the same as that which has been used in the polar regions for many years, to overcome the extreme convergency of the meridians, Figure 3. In mid latitudes the practice is to use as the reference datum the north direction of the meridian of departure, destination or midway point, since track orientation is then more nearly aligned with conventional true north, Figure 4. The choice of the reference meridian depends upon the length of route, conditions at departure or destination, or just the navigator's personal preference.

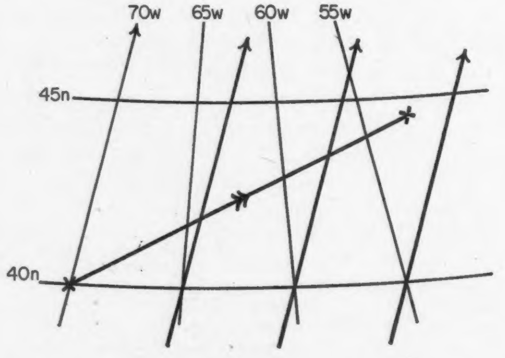


Figure 4
An illustration of the grid system used in mid latitudes to reduce the effect of convergency when steering by the directional gyro

As already mentioned, grids based on the cone constant of the chart do not eliminate transport wander entirely. This was not particularly significant in the past because of the slow aircraft speeds and the large real wander rates of the gyros. At the speeds of today's aircraft residual transport wander can be much larger and, since it can exceed the real wander of the new gyros, it must be considered, Figure 5. One method of overcoming residual transport wander is to use an earth convergency grid, i.e. a grid based on the actual convergency of the meridians and not the cone constant of the chart. SAS have used this technique on their mid latitude routes and have found it quite practical. When used with manual techniques, as is necessary with current navigation equipment, it can be displayed as an overlay on the chart, or in the form of a graph or table. The current grid techniques, although a necessity when navigating today's jet transports, have two significant faults:

(a) Grid north is neither true nor magnetic, except at the reference meridian. This necessitates realignment of the compass system when departing from or entering terminal areas, as traffic and all terminal aids are oriented to magnetic north.

(b) Current grids are not easily integrated with automatic DR systems which give position in terms of latitude and longitude.

PRESENT SITUATION

To summarize, the primary navigation system being installed in most jet transports today consists of the Along and Across Track Computer coupled to a gyro magnetic compass, and a doppler radar which provides continuous inputs of drift and ground speed. The across track error is fed as a correction signal to the auto control unit so that the aircraft will automatically fly along the desired path. This is not an automatic navigation system, as the directional element requires special attention and the DR position must be checked by fixes. Fortunately for the aircrew, by having drift and ground speed always available more time can be devoted to the heading system and to obtaining fixes to confirm the automatic DR position.

As there is no indication that a global navigation aid will be available for some time to come, astro, Loran and Consol will remain the primary fixing aids for the en route navigation of current aircraft. On the other hand, automatic DR systems are approaching reality. As soon as the manual aspects of the grid system are made automatic, a completely automatic and integrated DR navigation system will be feasible. Although this automation is not a requirement when navigating current transports flying at 7 to 8 miles/min, it will be for the Mach 2-3 jet transports flying at 25 miles/min.

Before a completely automatic and integrated DR system can be produced, the elements of the system that remain to be automated are the gyro reference system and its astro monitor. The basic characteristics of these components are already taking shape. For example, SAS, in an attempt to completely eliminate transport wander, now use manual grid techniques based on earth convergency. This trend towards grid techniques that use the actual convergency of the meridians is an attempt to take full advantage of the more precise directional gyros now entering service. Future navigation systems will also use the actual convergency of the meridians to automatically correct for transport wander, in addition to an automatic correction for earth rotation. Both corrections are a necessity in supersonic transport navigation systems. Although the directional gyro provides an accurate and stable heading, it must be aligned to a reference and checked at regular intervals. This is presently carried out manually by the navigator taking a bearing on a planet or star with the periscopic sextant. To guard against errors when attempting to read several dials simultaneously during the heading check, Trans-Canada Air Lines is installing a synchronous astro compass. The requirement for this refinement is brought about by the need for more precise heading data and it may be the forerunner to the development of simple semi-automatic celestial trackers for future high speed transport aircraft.

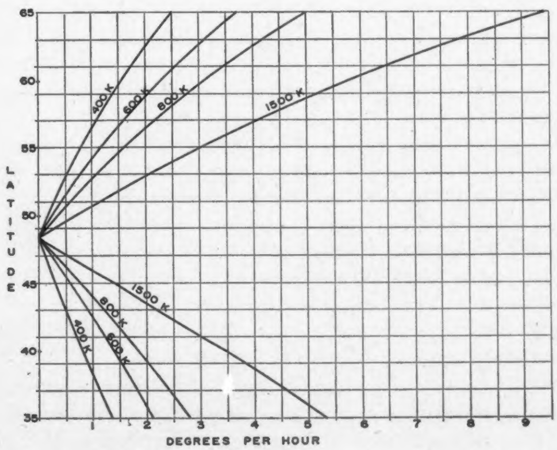


Figure 5
Residual transport wander on E-W flights using an aircraft position chart with a cone constant of 0.748

MACH 2-3 TRANSPORT NAVIGATION SYSTEM

The trends and developments in navigation equipment and techniques reviewed in the foregoing paragraphs provide an indication of the concept and characteristics of the navigation system for the first supersonic transport. In fact, very little development work remains before a fairly simple but fully automatic and integrated DR navigation system could be available for these aircraft.

Operating environment

It would take many paragraphs to fully describe the operating environment of the supersonic transport. This is not necessary, however, and only the environmental factors that have a direct bearing on the design concept of the navigation system will be considered.

Except for an increase in speed and cruising altitude, the flight profile for the supersonic transport will be very similar to that of today's jet transports. The climb to operating altitude will be at subsonic speed probably not much higher than that of current Boeing 707's and DC-8's. On reaching the assigned route altitude, in the neighbourhood of 50,000 ft, a cruising speed of about 1500 kts will be maintained until descent to destination is started, where the speed will again be reduced to about that of current jet transports. During the climb and descent phase of the flight the aircraft will, in nearly every case, be directed by the ground control system.

As one can well imagine, flight times will be quite short with the longest commercial routes not exceeding 3 to 4 hrs. A flight from Montreal to London, England, will take about 1 hr 55 min. The Montreal-Vancouver route will require about 1 hr 20 min, with the aircraft over Winnipeg about 40 min after departing Montreal. Speeds of this nature have a pronounced effect on the rate of change in direction of the desired flight path. For example, on the London flight, true direction along the great circle route will change at the rate of about 1° every 2 min and mag-

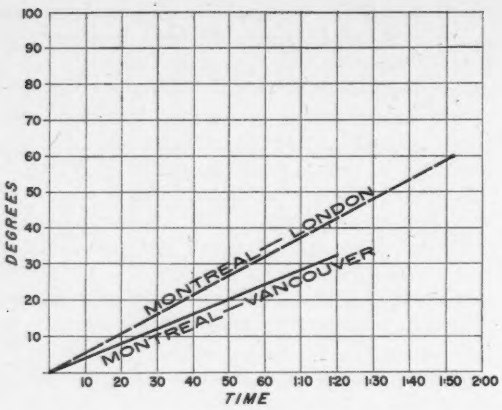


Figure 6
An illustration of the rate of change in true heading when flying at 1500 kts

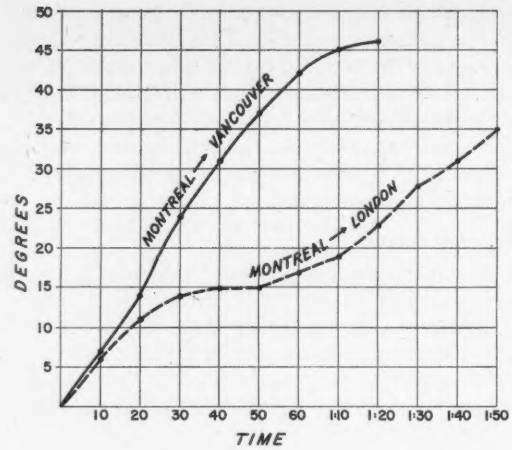


Figure 7
An illustration of the rate of change of magnetic variation when flying at 1500 kts

netic variation about 1° every 3 min. Between Montreal and Vancouver the rate of change of true direction will be about 1° every 3 min and variation 1° every 2 min (see Figures 6 and 7). This rapid change of heading must be considered in the design of the navigation system.

No major changes in the en route fixing aids used by today's airlines flying the global routes will have taken place by the time the first Mach 2-3 transports enter service. Loran and Consol will still be the primary ground based aids along the main global routes; Astro will still be used for fixing, and its role in providing heading checks will be as important as ever. Except possibly for a few experimental installations with limited coverage there will be no global ground based radio aid available for automatically feeding fix information into the integrated navigation system. The assumption that no common global navigation aid will be available when the first supersonic transport enters service has a considerable influence on the basic design of the navigation system.

Automatic position reporting will probably be employed along the more congested routes. If so, the type of readout of present position from the navigation system is a factor to be considered. There is no reason to suggest that the normal geographical coordinate system is not satisfactory for this purpose. However, current computers which display only position in relation to desired track and destination will not be suitable.

Along continental routes and in the terminal areas magnetic north will be used for the directional reference. Short range "bearing and distance" systems and radars will probably be the primary fixing aids. These factors must also be considered in the design of the navigation system, as there must be a simple transition from the en route to the terminal navigation condition. Automatic ground control in the terminal areas will not be in common use and need not be considered in the basic design of the navigation system. Although great strides will have been made in the use of computers to correlate and handle traffic, information will still be passed between the traffic control system and the aircraft by the human link and, in the terminal areas, the aircraft will be manually manoeuvred by the pilot according to directions provided by the traffic controllers. Automatic approach and landing aids, beyond improved versions of current approach couplers and flight directors, will not be in general use nor will their requirement be any greater than for the current jet transports.

System concept

From the analysis of the operational environment and taking into account the other factors already discussed, the following conclusion can be drawn regarding the basic concept of the navigation system for the first supersonic transports.

The manually linking together of the navigation sensors, computer and directional element, when flying at 25 miles/min, is out of the question and a fully integrated and automatic navigation system is required. Moreover, it will be basically a DR system as no global fixing aid with the desired characteristics for integration with an automatic navigation system will be in wide use. Although many of the major intercontinental routes will be covered to some degree by radio aids, they will only be used to supplement the aircraft's self-contained system rather than being an integral part of it.

The system must not be limited by the length of the route or range of latitude. It must lend itself to easy transition from en route navigation to providing an aid in terminal areas. Although the system will not use the magnetic reference for en route navigation for reasons already discussed, it must provide magnetic orientation in the terminal areas and for use with certain short range radio aids which are oriented to magnetic north.

Fundamentally, the system will consist of three main components: a sensor which will provide certain basic information for determining flight progress; a central computer that will determine position, track, distance and provide the information required to maintain the desired track; and a flight control component

which consists of an autopilot, its associated units, and an all-attitude reference unit which will also provide the directional reference for the system.

A simplified diagram of the system is shown in Figure 8. This outline of the basic concept of the system in no way attempts to show the cross references, back up circuits or couplings required to complete the system.

Navigation sensors

The three sensors that can be considered for the system are inertial, astro and doppler or combinations of these. The use of automatic astronomical observations to provide inputs to determine flight progress is not considered practical, since normally two celestial bodies must be observed to obtain all the components required for navigation. This is not easily accomplished during daylight hours, although it can be done at great expense. Moreover, automatic astro fixing devices are not easily integrated with automatic navigation systems. Difficulty with vertical alignment makes it doubtful whether fix accuracies better than 8-10 miles can be achieved with these devices. The primary role that astro will play in the future is in monitoring the directional reference system. Star trackers are being developed for this purpose, and it is in this role that astro will play an important part in the navigation of supersonic aircraft – not as a fixing aid.

Within recent years progress in the development of inertial navigation systems has been very rapid, and many enthusiasts claim that inertial represents the ultimate in navigation techniques. This may be so for certain aircraft and roles but it hardly applies to transport aircraft. Although inertial systems will be available and could provide the desired accuracy for the flight durations considered, they could only do so at a price that would not be competitive with the cost of doppler sensors of comparable accuracy. It is unlikely that inertial systems will have overcome the lead that doppler has attained by the time the supersonic jet transports are flying. Although doppler is only just becoming widely used in transport aircraft, the results obtained, both in accuracy and reliability, are very good. It is difficult to imagine operators going to another sensor which will lack the operational background that doppler will have acquired by this time. Moreover, by the time the supersonic transport enters service, many refinements will have been added to current doppler systems and their reliability will be comparable to the main electrical system of the aircraft. Fundamentally the doppler sensors that will be installed in the supersonic transports will not differ greatly from those now coming into use.

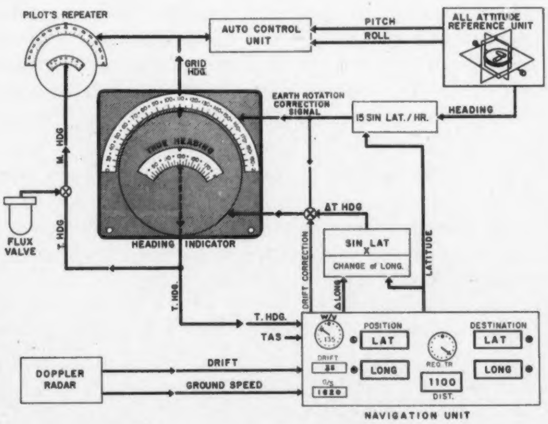


Figure 8
A simplified diagram of an automatic navigation system for a Mach 2-3 transport aircraft

Hybrid systems have been developed which combine two or more self-contained sensors to take advantage of the individual merits of each aid. For example, by combining an inertial system with an automatic astro tracker, the inertial device will provide a very accurate reference from which to measure the altitude of a celestial body. By combining inertial and doppler, the long term accuracy of the doppler can be used to correct the inertial system; this combination results in a greater accuracy over a longer time period than can be obtained when using the inertial system independently. While self-contained hybrid aids have a place in military operations, their high cost and complexity will rule them out as sensors for automatic navigation systems for civil transports – at least for many years.

Search radar, although not an integral part of the navigation system, will be required primarily for storm avoidance in all supersonic transports. Similarly, there will be other aids installed which will supplement the automatic navigation system but will not actually be part of the system. These aids will be the airborne components of the ground based systems covering the more congested intercontinental routes and the terminal areas.

Central computer

The heart of the navigation system is the central computer. It will receive inputs of true airspeed, true heading, drift and ground speed. With this information, and with the geographic co-ordinates of the destination or checkpoint manually pre-set, it will automatically compute present position, required great circle track, distance to go, and wind velocity. The information presented to the "system monitor" by the computer by means of dials or Veeder root counters will be wind velocity, drift angle, ground speed, present position, required track, and distance to the destination. The outputs from the computer will be latitude and change of longitude which will be used to automatically correct the heading for apparent wander due to convergency and earth rotation. The correction for wind drift will also be supplied to the auto control unit by the computer. Provision will be made for setting in an alternative destination or checkpoint to provide flexibility in computer operation. An Estimated Time of Arrival meter is not required since it is a simple matter to check the ETA against actual time of arrival and make adjustments accordingly.

Flight control component

This component of the system will consist of the autopilot and its associated units, such as control coupler and flight director for automatic approach and

landing, and an all-attitude reference unit. As the autopilot and its associated units will not differ greatly from those in current use, they will not be discussed. In a supersonic transport, an all-attitude reference unit will replace the current gyro magnetic compass as the primary directional instrument. This unit is basically a stable platform which will provide correction signals for pitch, roll and yaw to the flight control unit and heading to the navigation system. The random precession of the platform will not exceed 1° for 4 hrs — an accuracy that is not difficult to achieve today. The initial alignment of the all-attitude unit will be to the local meridian and will be accomplished by means of a photoelectric, semi-automatic astro tracker, or a synchronous astro compass coupled to a periscopic sextant. The auto control component will maintain the desired direction with reference to the initial meridian but true heading will also be shown for each meridian as it is crossed. This, of course, is required by the central computer to determine present position in geographical latitude and longitude. The output from the flight control component will be presented simultaneously in three modes:

(a) as a reference signal to the autopilot which is offset from the initial desired track by an amount equal to the wind drift so that the aircraft will automatically fly the desired track,

(b) as true heading to the central computer, and

(c) as true heading to the pilot's indicator where magnetic information from a flux valve will be applied and the readout will be magnetic heading.

The readout of magnetic heading on the pilot's heading indicator provides the directional reference link with the magnetically oriented terminal aids and ground control systems. This indicator can also be used to provide readouts for bearing and distance type terminal aids and, of course, provision should be made to couple these outputs to the auto control unit if desired.

To summarize, the system will function as follows. In the terminal areas the aircraft will be steered by magnetic reference and probably under the direction of the ground control system, but on arriving at the point where en route navigation commences, the all-attitude reference system will be aligned to the local meridian by celestial. Before setting course, the navigator (or system monitor) will manually pre-set the co-ordinates of the departure point, and the first checkpoint or destination. The computer will then automatically determine the great circle track and distance. At departure, true and grid heading will be the same, and the difference between the grid heading fed to the autopilot by the central computer and the required track indicated by the computer will equal the doppler drift. As the flight progresses, the computer will continuously indicate the required great circle track and distance between present position and destination. True heading will change according to the convergency of the meridians and change in drift. A cross check on the proper functioning of the computer will be a comparison of the required track with true heading. The difference should equal the indicated drift.

The pilot's directional indicator will show the magnetic heading of the aircraft which will change as the flight progresses. The grid heading may also be indicated to the pilot but this is not absolutely necessary. The basic design of this system readily lends itself to incorporating a star tracker, although the function of the tracker could be handled by a synchronous astro compass coupled to a periscopic sextant. Recent developments in astro trackers indicate that a simple and economical, though not fully automatic, version could be available for incorporation into the system.

CONCLUSION

The system concept outlined in this paper provides the flexibility required of an automatic navigation system for long range intercontinental supersonic transport aircraft. It has no latitude limitations and can be used as easily at the poles as at the equator. The human link between the sensors and flight controls has been eliminated — a major factor to be considered in the design of a system for these aircraft. The additional factors of complexity and cost were also kept in mind and, as a result, this system, although capable of meeting foreseen requirements, does not represent the sophistication in equipment that the state of the art could produce. Moreover, very little development is required before the system could be put into operation. No attempt has been made to outline a completely integrated en route and terminal automatic navigation system. This is, of course, the ultimate requirement; however, many problems remain to be solved, and decisions have to be made regarding the configuration of the terminal aids before the complete airborne system can be outlined. The fact remains — there is no one system common to both en route and terminal navigation! At best the en route system can be made to receive inputs from the terminal aids. The automatic system described above provides the link, but the transition is still manual and must be carried out by the pilot after the en route system has placed the aircraft in the proper geographical position.

The flight crew of a supersonic transport aircraft will probably consist of three, and their primary task during the en route phase of the flight will be the monitoring of the navigation system and checking on the progress of the flight.

NOTICES TO AIRCRAFT MAINTENANCE ENGINEERS

Issued by the Department of Transport

The Department of Transport, Air Services, Civil Aviation Branch, has promulgated the following Notices to Aircraft Maintenance Engineers:

No. 9/61

Issue 1: April 18, 1961

The F.A.A. have promulgated the following Airworthiness Directives:

#61-5-2 – applying to certain Douglas DC-6 and DC-7 Models.
#61-5-3 – applying to Fairchild F-27 Models.
#61-5-4 – applying to Hiller UH-12D (H-23D) and UH-12E Models.
#61-5-5 – applying to all T-28A Models (supersedes AD 58-24-3).
#61-5 – contains revisions to AD 60-9-4 applying to Vickers Viscount 745D and 810 Models.
#61-6-2 – applying to certain Cessna 150 and 150A Models.
#61-6-4 – applying to Douglas DC-8 Models.
#61-6-5 – applying to Douglas DC-8 Models.
#61-6-6 – applying to Piper J-4, J-5, PA-12, PA-14, PA-15, PA-16, PA-17, PA-20 and PA-22 Models.
#61-6 – contains revisions to AD 60-10-2 applying Brantly B-2 Models.
– revisions to AD 47-27-2 applying to Douglas DC-4 Models.
– revisions to AD 60-3-8 applying to Piper PA-23 Models.

No. 10/61

Issue 1: April 20, 1961

The following Airworthiness Directive has been issued:

61-5

DHC-3

Installation of improved oil delivery lines of the constant speed unit, as described in the de Havilland Engineering Bulletin Series "O", No. 68, Issue 2, applicable to all DHC-3 Otter aircraft prior to Serial No. 390, except 320, is mandatory. Compliance is required at the next engine overhaul or as a replacement part.

Aircraft complying with Airworthiness Directive 60-7 must be inspected for the presence of P & W gasket 7674 and, if not installed, the installation of a new P & W gasket 7674 must be made as outlined in procedure step 10.

This supersedes Airworthiness Directive 60-7.

This Directive will be included in Amendment List No. 14 to the Engineering and Inspection Manual.

No. 11/61

Issue 1: May 12, 1961

The Beechcraft C18S aircraft which was manufactured prior to and during World War II is similar in many respects to the D18S model, but conforms to a different FAA specification No. A-757.

While checking the availability of maintenance manuals and inspection forms for the C18S model it was found that the stock of these items had been depleted, and would not be republished. In accordance with the recommendation of Beech Aircraft Corporation, makers of Beechcraft C18S aircraft, it is now established that all Model C18S aircraft registered in Canada must be maintained in accordance with the requirements of Beechcraft maintenance manual and inspection forms, as applicable to the D18S model.

The maintenance manuals and forms for the 100 hour, 1000 hour, 3000 hour and 5000 hour inspection may be obtained from a Beechcraft distributor, or directly from the Service Parts Sales Department, Beech Aircraft Corporation, Wichita, Kansas.

Reference should be made to FAA Spec. No. A-757 for flying control surface rigging data, and required equipment for the C18S model aircraft.

No. 12/61

Issue 1: May 12, 1961

There appears to be some misunderstanding among the AME's regarding the incoming certification required for aircraft components imported from the United States for use on an aircraft registered in Canada.

The Engineering and Inspection Manual Part I, Chapter 3, outlines the classification of components and the type of certificate or tag required for each. The same documents are required for *both new and used* aircraft components being imported, and in the case of tags these must be attached to each item.

When components from an aircraft registered in Canada are sent to United States for overhaul or repair the documents required are detailed in Part I, Paragraph 3.1.16 of the Engineering and Inspection Manual, and should not be confused with those required for new or used components being imported.

No. 13/61

Issue 1: May 24, 1961

The following Airworthiness Directives have been issued:

61-6

Bell Helicopters

Applies to all Model 47 Helicopters using Metal Main Rotor Blades P/N 47-110-250-11

Due to the possibility of a faulty bond between the butt plate laminates of the Main Rotor Blades, the following mandatory inspection is required during the 25 hours flight time preceding the flight, or during the seven days preceding the flight, whichever period is shorter and the blades certified as airworthy by an AME Category 'R'. Inspect the butt plate laminates for indication of bond separation by grasping the blade at the tip and coning blade downward slightly after the static stop is contacted, then coning blade upward to extent that the tip is above the level line of

the yoke. If blade separation is found, the blades must be replaced.

This cancels Airworthiness Directives 59-2 and 59-4.

61-7

Boeing 75 Series

In view of the fuel gauge sight 'glass' failures on Boeing 75 Series aircraft, replacement of the fuel gauge sight 'glass' is mandatory. Compliance is required within 10 hours of operation for aircraft fitted with gauges that have been in service more than twelve months and must be replaced every twelve months thereafter.

No. 14/61

Issue 1: June 8, 1961

The F.A.A. have promulgated the following Airworthiness Directives:

#61- 8-2 – applying to Rupert Safety Belts.
#61- 8 – contains revisions to AD 61-5-3 applying to Fairchild F-27 Models.
#61-10-1 – applying to Beech 35 Models.
#61-10-3 – applying to Fairchild F-27 Models.
#61-10 – contains revisions to AD 61-3-1 applying to Bell 47J-2 Models.
– contains revisions to AD 61-5-4 applying to Hiller Models.

No. 15/61

Issue 1: June 15, 1961

The following Airworthiness Directives have been issued:

61-8

Bell Model 47 Helicopters

It has been ascertained that some Model 47 Helicopters Bubble Assemblies have been released which do not conform to the approved data for Bubble Assemblies P/N 47-360-181-153 and P/N 47-360-181-119.

All Bubble Assemblies must be checked for conformity. Those which do not conform must be replaced not later than July 1, 1961.

61-9

Canadair

DC4M2, C-4 and C-4-1

Applies to all DC4M2, C-4 and C-4-1 Aircraft

The inspection and repair of cracks in the upper and lower front and centre spar caps in the area of wing station 60 as specified in Canadair Service Bulletin No. GB 20 is mandatory.

No. 16/61

Issue 1: June 20, 1961

On the recommendation of the manufacturer, as a result of its fine service record, the basic overhaul period for the Pratt & Whitney R2800 CB Series Engine is increased from 1000 hours to 1200 hours.

Para. 6.3.5, Chap. VI, Part I, of the Engineering and Inspection Manual will be amended accordingly in due course.

No. 17/61

Issue 1: July 5, 1961

The following Airworthiness Directive has been issued:

61-10

De Havilland

DHC-4

Applies to Model DHC-4 Aircraft Serial Nos. 2 through 17.

Compliance required not later than 50 hours' time in service after July 1, 1961.

Owing to the possible substitution of Chobert blind rivets for AN 470AD-4 solid rivets during manufacture, inspect the rivets attaching hinge plates P/N C4-W-1221-21 to the outboard hinge arms P/N C4-W-1221-1, -2 on the inboard trailing flap assemblies C4-W-1203-3, -4. If Chobert rivets have been used to attach the plates, they must be removed and replaced by 1/8 Huck rivets P/N CKL-P4F or 5/32 Huck rivets P/N CKL-P5E. Hole sizes must be within the limits recommended by the rivet manufacturer. There are nine rivets attaching each plate.

De Havilland Aircraft of Canada Engineering Bulletin Series DHC-4 No. 11 covers this subject and shows the location of the parts affected.

This Directive will be included in Amendment List No. 14 to the Engineering and Inspection Manual.

No. 18/61

Issue 1: July 27, 1961

The F.A.A. have promulgated the following Airworthiness Directives:

#61-11-1 – applying to Brantly B-2 Helicopters.
#61-11-2 – applying to Brantly B-2 Helicopters.
#61-12-1 – applying to Douglas DC-8 Models.
#61-12-3 – applying to Navion, Twin Navion, Camair Model 480, Dauby, Riley and Temco Models D-16 and D-16A.

No. 19/61

Issue 1: August 4, 1961

The following Airworthiness Directive has been issued:

61-11

de Havilland

DHC-4 Series

Applies to DHC-4 Series Aircraft Serial Nos. 2 through 22, 24 and 25.

Compliance required as indicated.

(a) *Inspection and field repair*
Prior to 500 hours time in service, and at intervals of 100 hours service time thereafter, inspect the rudder rib flanges for cracks adjacent to the stringer cut-outs as described in Part A of de Havilland Aircraft of Canada Modification Bulletin No. 4/1101, Issue 3. Repair any cracks found as detailed in sheets 1 and 2 of this Bulletin.

(b) *Modification*
If a total of 10 or more cut-outs are cracked (found on initial inspection or re-inspection) the rudder must be retired from service until the modification detailed in Part B of the Bulletin has been accomplished (Mod. No. 4/1101).

(c) When Mod. No. 4/1101 has been accomplished, the inspections required in (a) may be discontinued.

No. 20/61

Issue 1: August 11, 1961

The F.A.A. have promulgated the following Airworthiness Directives:

#61-13-2 – applying to Piper PA-25 Models.
#61-13-3 – applying to Schleicher Model K-7 Gliders.
#61-14-1 – applying to Aero Commander 500 Models.
#61-14-2 – applying to certain Models of Bell 47 Helicopters.
#61-14-5 – applying to Lockheed 1049 Series Aircraft.
#61-14 – contains revisions to AD 58-17-2 Curtiss C-46 Models.
– contains revisions to AD 60-10-4 Lockheed 1049 Series.
#61-15-1 – applying to Beech D18S Models.
#61-15-2 – applying to Fairchild F-27 Models.
#61-15-3 – applying to Fairchild F-27 Models.

CANADIAN AERONAUTICAL INSTITUTE

C.A.I. LOG

SECRETARY'S LETTER

It is always rather difficult to write this Letter after the summer recess. A good many things happen between the Annual General Meeting and the beginning of the next season, and they are all mixed up with our holidays and other distractions. However I shall try to disentangle the salient events and report them as best I can.

TURNBULL FIELD

In 1957 we began to think of our programme of celebrations of the 50th Anniversary of Flight in Canada, to occur in 1959. We were on the lookout for projects of historical significance, and one of the suggestions was the naming of the new municipal airport at Saint John, N.B., in memory of Dr. W. Rupert Turnbull. Dr. Turnbull was born in Saint John and spent most of his life in nearby Rothesay. The "Turnbull Field" proposal was at first rejected by the local authorities but fortunately the work on the airport was delayed long enough for them to change their minds. Last year they told us of their intention to adopt the suggestion and asked us if we would furnish a plaque, as we had originally offered to do. We readily agreed and arranged for the plaque to be made by Frederick Sage & Company, in England, with whom Dr. Turnbull had worked during the 1914-18 War.

The dedication of the field took place on the 20th June, at the same time as the new terminal building was opened. The plaque was unveiled by Mr. Donald Turnbull, Dr. Turnbull's eldest son, after Mr. M. S. Kuhring (who was largely responsible for the original suggestion) had given a brief account of Dr. Turnbull's achievements. For the ceremony, the plaque and an explanation of who Dr. Turnbull was and what he had done, with a reproduction of one of his drawings, very effectively prepared by a local firm, were mounted on a temporary board equipped with curtains. They have since been permanently mounted on the wall of the new building.

I hope that any of our members passing through Saint John will take a look at them.

J. A. D. McCURDY

Air Commodore the Honourable J. A. D. McCurdy, who flew the Silver Dart at Baddeck, N.S., on the 23rd February, 1909, thereby becoming the first British subject to fly in the British Empire, died in Montreal on the 25th June. His funeral, on the 28th June, was conducted with full military honours and attended by a good many members of the Institute. It was an impressive occasion. Later his ashes were interred at Baddeck, where he was born. During my holiday I visited his grave, in a quiet little cemetery overlooking Lake Bras d'Or and the site of his famous flight.

Mr. McCurdy had been sick for some weeks and was unable to present the McCurdy Award at the Annual

Mr. D. O. Turnbull, son of Dr. W. R. Turnbull, unveiling the plaque and an engrossed summary of Dr. Turnbull's life and work at the dedication of the Saint John Airport. The plyboard mounting was a temporary rig for the ceremony.

General Meeting in May. He had always taken a keen interest in the Institute – as indeed he did in everything aeronautical – and we shall miss him at our gatherings.

THE INSTITUTE'S NAME

During August, the membership was asked to vote on a recommendation by the Council that the Institute should change its name. The official result of the ballot is reported in the Announcements on page 275.

Although there was a substantial majority in favour of a change, it was not sufficient to carry the proposal. The Bylaws lay down that the name of the organization shall be the Canadian Aeronautical Institute and it requires a two-thirds majority to carry an amendment to the Bylaws; in this case it would have required 576 favourable votes, and 552 was not enough. So we shall remain the Canadian Aeronautical Institute for the time being.

There have been several comments on the ballot, arguing that space is but a natural extension of the field of interest of the aeronautical fraternity and that the Institute's reputation will depend upon its activities in the space sciences rather than upon its name. This is very true but it means that every member must make it his business to emphasize to his friends, especially to the younger ones, that 'space' is just as much the Institute's business as 'air' is. The underlying motive for the Council's proposal was to improve the "public image" of the Institute. The public, at present, does not associate the word "aeronautics" with orbits and satellites and such, and this is proving a real handicap to the Institute's growth – particularly among students, from whom our future membership must spring, and in the electronic fields, which find themselves already involved in space research and encroaching upon the threshold of space explorations.

Some of the comments received criticized the proposal as unjustifiably expensive, involving, as it would, extensive changes in the Institute's stationery and hardware. This point had been carefully weighed by the Council, who had concluded that the money would be well spent if it served to spread a wider sail to the rather fitful breezes of our times.

The Council's recommendation had not been made hurriedly and stemmed from long study by the Planning Committee. Incidentally the suggestion of a new name proved a much tougher problem than the suggestion that there should be one. Several names were submitted by members in the course of the ballot, but I do not think that any one of them had not been previously considered and debated by the Planning Committee, and rejected for one reason or another. Ideally we want to express the "nautics" idea – but "nautical" would hardly do!

For the present it must be "aeronautical" – as defined in the Bylaws, to refer to "all forms of flight by physical means both in and beyond the atmosphere of the Earth". And it's not a bad word either.

MEETING NOTICES

For the Astronautics Symposium, to be held after the IAS/CAI Meeting, we are trying a new form of notice and, if it is successful, we are likely to adopt it for all future meetings. The loose sheet inserted in this issue of the Journal, together with the programme printed on page 284, is the only notice that will be issued; no poster-type notice, with its accompanying reservation cards etc, will be distributed. There are, of course, disadvantages to this plan but it is likely to effect considerable economies in both money and effort.

DUES

I would remind those members who have not yet paid their dues for 1961/62 that the deadline is drawing near and that, if they have not paid by the 1st October, they will be considered to have fallen into arrears and will be deprived of certain privileges.

BRANCHES

Montreal — 18th August

The only Branch activity worthy of note during the summer months was the Montreal Branch annual Golf Tournament, which was held on the 18th August, under the able and traditional guidance of Mr. J. R. Chadborn. This year it was an even greater success than before. Other Branches could do worse than devise some similar diversion before settling down to the season's business.

I hope that all the Branches will have successful programmes in the coming months. The President and I will try to make the rounds to visit you.

ANNOUNCEMENTS

NEWS OF MEMBERS

C. J. Luby, A.F.C.A.I., has resigned as Joint Managing Director of Dowty Rotol Ltd. and accepted an invitation to join the Board of the Bristol Aeroplane Co.

Dr. B. G. Newman, A.F.C.A.I., was joint-recipient this year of the Edward Busk Memorial Prize, awarded by the R.Ae.S. for the most valuable contribution on Applied Aerodynamics.

J. D. G. Stevenson, M.C.A.I., has been promoted to Manager, Aero Sales, Sperry Gyroscope Co. Ltd., England.

G/C C. R. Thompson, M.C.A.I., has been posted to RCAF Stn. Trenton where he has assumed the duties of Commanding Officer, No. 6 Repair Depot.

A. L. Bartlett, Technical Member, has been appointed Field Service Manager, Special Projects – Europe, Laboratory for Electronics, Inc., N.Y.

R. R. Finney, Technical Member, of Railway & Power Engineering Corp. Ltd., has been appointed Technical Sales Representative in the Montreal area.

J. A. Murray, Technical Member, has been appointed Western Region Representative of Collins Radio Co. of Canada and is situated at Calgary.

H. A. Talbot, Technical Member, of Railway & Power Engineering Corp. Ltd., has been transferred to Ottawa and is now Ottawa District Representative.

DEATHS

It is with deep regret that we record the recent deaths of

Hon. J. A. D. McCurdy, Hon. F.C.A.I.
Dr. E. R. Sharp, F.C.A.I.
Dr. A. L. M. Grzedzielski, A.F.C.A.I.
CDR J. H. Johnson, M.C.A.I.

ADMISSIONS

The following is a list of admissions and advancement in grade of members during the month of July 1961.

Associate Fellow

J. M. Duggan (*from Member*)
M. H. Satchell (*from Member*)

Member

W. F. Dawson
S. B. Fleming (*from Technical Member*)
LCDR W. H. Frayn (*from Technical Member*)
G. Fryer (*from Technical Member*)
L. T. Harber
H. D. Johnson (*from Technical Member*)
J. G. A. J. Lafeber
G. A. McElroy
F/L A. F. Routledge
H. I. H. Saravanamuttoo (*from Technical Member*)
J. C. Thompson
R. H. Yenney

Technical Member

Cpl. A. T. R. Droppo
G. Kurylowich
F/O A. Proulx (*from Student*)

Junior Member

D. M. Cowan (*from Student*)

Student

K. Dau
R. W. Valentine

OBITUARY

Hon. J. A. D. McCurdy, Hon. F.C.A.I.

The passing of the Honourable John Alexander Douglas McCurdy on the 25th June, 1961, born 2nd August, 1886, takes away the last link with the great historic Aerial Experiment Association.

John McCurdy was a graduate in Mechanical and Electrical Engineering from the School of Practical Science, University of Toronto, in May 1907. During his undergraduate days, he held the Fencing Championship, being granted his First Colour. It was while playing football that he formed a great friendship with Casey Baldwin. In 1906 he invited Baldwin to come to Baddeck with him where the two friends became interested in Dr. Bell's aviation experiments. After graduation he returned to Baddeck and became one of the Aerial Experiment Association members which was formed by Dr. Bell with Baldwin, McCurdy, Lt. Selfridge and Curtiss on the 1st October, 1907.

The AEA built four aircraft, the fourth of which was the famous Silver Dart flown off the ice on Bras d'Or near Baddeck on the 23rd February, 1909. John McCurdy thereby became the first Canadian to fly in Canada and also the first to fly in the British Empire. The Golden Celebration of this flight was held on the 23rd February, 1959, when a replica of the Silver Dart was flown at Baddeck in the presence of John McCurdy. This replica is now in the National Aviation Museum at the Ottawa International Airport.

One has only to look at this slender machine held together by wires and wooden members to wonder at the courage of these men who had no one to teach them to fly. It is doubtful whether John (or Doug as we always called him in the old days) ever gave it a thought. Adventure was always sought after by him.

During World War I he managed a factory in Toronto building Curtiss JN-4's and also a Flying Training School at Long Branch and Toronto Island, graduating many pilots for the RFC and RNAS. There is in my possession a copy of the menu of a dinner held by the first class to graduate. There are signed on it the names of many famous pilots along with John McCurdy. They have nearly all "gone west" and now they are joined by this great pilot of the Silver Dart.

During World War II he served under the Honourable C. D. Howe as Assistant Director of Aircraft Production and later as Supervisor of Purchasing.

At the CAI Dinner held in the evening of the Golden Anniversary, the RCAF made him an Honorary Air Commodore which he appreciated more than the many honours he had accumulated. The University of Toronto also granted him the degree of LL.D. as their part of the celebration.

He was Lieutenant Governor of Nova Scotia from 1947 to 1952. Government House in Halifax was famous for hospitality during his term.

Dr. Bell wrote on the completion of the AEA project to accomplish practical powered flight, "The Aerial Experiment Association is now a thing of the past but it has made its mark on the history of aviation and its work will live".

There are many more items in the life of this very active man which might be recorded and which have borne out Dr. Bell's prediction. Perhaps it is sufficient to say that he became a legendary figure among those of whom it is said, "Their Name Liveth for Evermore".

PROFESSOR T. R. LOUDON

Dr. A. L. M. Grzedzielski, A.F.C.A.I.

Dr. Grzedzielski was born in Jaworzno, Poland, on the 27th February, 1898. He was the son of Wladyslaw and Maria Grzedzielski.

He received his early education in Lwow, Poland, and graduated in Mechanical Engineering in 1924 from the Technical University. Following his graduation he was employed for six years as a designer in an aircraft manufacturing company and then entered the Technical Institute for Aircraft in Warsaw as a research engineer. In 1939 he obtained his Doctor of Engineering from the Technical University in Warsaw, and left Poland for France where he resided until 1942. In that year he came to Canada and worked in Montreal as an aeronautical engineer in the Canadian Car and Foundry Company.

From 1944 to 1946 Dr. Grzedzielski was a professor at Ecole Polytechnique in Montreal and from 1946 to 1950 he was a lecturer in Civil Engineering at the University of Toronto.

In 1950 he joined A. V. Roe (Canada) Ltd., as a stress engineer and became Section Chief in charge of the overall stress analysis of prototype aircraft.

Dr. Grzedzielski joined the staff of the National Research Council in May 1959 where he has been employed as a Senior Research Officer in the Structures Section of the National Aeronautical Establishment.

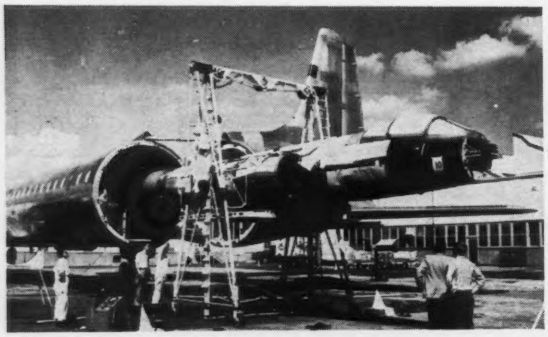
He was an Associate Fellow of the Canadian Aeronautical Institute, a Member of the Institute of the Aerospace Sciences, and a member of the Association of Professional Engineers of Ontario. He was also a member and Past President of the Association of Polish Engineers in Canada.

Dr. Grzedzielski was an exceptionally gifted scientist, who in recent years had specialized in the theory of shells and in advanced methods of analysis of composite structures and, in particular, in the analysis of the structure of high speed aircraft. He had early recognized that the development of high speed electronic computers could become a powerful tool for the structure analyst and had applied himself to the monumental task of providing the theoretical basis to which electronic computers could be applied. His work won him international recognition as a progenitor of a whole new analytic technique and pride-of-place among the dozen world leaders in this field of science. His death is a grievous loss to aeronautical science.

F. R. Thurston

SUSTAINING MEMBERS

Canadair Ltd. completed the function and reliability test flight programme of the CL-44 on the 4th June after 18 days continuous testing, involving 50 flights. Normal airline-type servicing procedures were followed on all flights and every aircraft system was evaluated under operational conditions. The swing-tail and all doors and hatches were operated; all equipment was checked-out in extremes of performance; emergency and manual override systems were tested; at least one engine was shut down and its propeller feathered on each flight; and fuel was dumped on five occasions. The majority of landings were made at the maximum landing weight of 165,000 lb. Full type-certification for the swing-tail Canadair Forty Four was issued on June 29 and the airplane has now entered commercial service with Flying Tigers and Seaboard World.



An F-104G goes aboard the CL-44.

A very impressive demonstration of the capability of this aircraft was carried out in August, when two complete F-104G aircraft were loaded aboard one swing-tail CL-44. The accompanying picture indicates the relative sizes of the aircraft, as one of the F-104G's is being inserted tail first into the capacious hold of the transport.

Canadian Pratt & Whitney Aircraft Co. Ltd. started test flying the PT6 engine in a Beech 18 test bed in June. The installation was done by De Havilland Aircraft of Canada at Downsview and the test programme is being carried out at St. Johns, Quebec (see cut).

The RCAF Expeditor converted as a flying test bed for the PT6 turboprop engine.

The engine completed its 50-hour Preliminary Flight Rating Test to USN specification in mid-July, with excellent results. Development of this engine has progressed satisfactorily from the first studies in the fall of 1958, start of design early in 1959, first run in February 1960 and subsequently over 1,800 hrs. of development running.

The Company has also announced the recent purchase of the Government-owned factory complex at Longueuil, formerly operated by the Gun Division of Canadian Arsenals Ltd., increasing their plant area by over 404,000 sq. ft. The additional space is required for the rapid expansion of the firm's operations in manufacturing, overhaul and research and development.

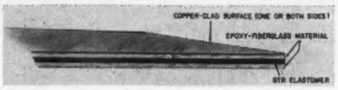
Collins Radio Company of Canada, Ltd. officially opened its new manufacturing facilities in East York, Toronto, on the 8th June. Together with the old building, which has now been completely renovated and serves as engineering headquarters, Collins Canada now has 85,000 sq. ft. of floor space. With the large increase in the size of its engineering facilities the Company is embarking upon Canadian design and development of a wide range of electronic equipment, both for defence and commercial purposes.

The wheel-ski installation on the Caribou.

De Havilland Aircraft of Canada Ltd. have developed a wheel-ski undercarriage for the Caribou, now being tested by the U. S. Army in Greenland (see cut). Conversion can be effected in 2½ hours with the aircraft standing on its wheels. Incidentally the gross weight of the Caribou has recently been increased to 28,500 lb. – from its original 26,000 lb.

Garrett Manufacturing Limited has available on request some interesting "Physiological Performance Charts" prepared by The Garrett Corporation of Los Angeles. It will be remembered that, a few years ago, this Company produced some other charts entitled "Atmosphere Chart" and "High Altitude Chart".

Railway & Power Engineering Corporation Ltd. has announced the development of the Dyna-damp Printed Circuit Board by Lord Manufacturing Company. This material, a cross-section of which is shown in the attached sketch, will enable designers of electronic equipment to achieve higher reliability in miniaturized packaging, free from structural or local circuit board resonances. The board is supplied copper-clad and ready for processing.



The Lord Dyna-damp printed circuit board.

THE NAME OF THE INSTITUTE

The following is the text of the report of the scrutineers, appointed by the President to supervise the recent ballot on the proposal to change the name of the Institute:

"The Council's recommendation regarding a change of the Institute's name was submitted to a ballot of the membership on the 27th July, 1961. Balloting closed on the 18th August. The envelopes were opened and the votes counted by the undersigned on the 21st August.

"Two issues were involved; first, whether the Institute should retain its name or change it to emphasize its interest in space and, second, if the name was to be changed, whether it should be changed to "Canadian Aerospace Institute" or "Canadian Aeronautics and Space Institute".

"On the first issue 863 ballots were cast; 3 ballots were spoiled. The voting was 552 to 308 in favour of changing the name.

"On the second issue 868 ballots were cast; 4 ballots were spoiled. The voting was 557 to 307 in favour of the name "Canadian Aeronautics and Space Institute".

J. A. G. Diack, W/C
E. Kosko
H. C. Luttman"

On legal advice, it is learned that the first issue implies an amendment of the Bylaws and therefore requires decision by a two-thirds majority in accordance with the terms of Article 13, Section 2 of the Bylaws. The resolution was therefore defeated and the name of the Institute will remain unchanged.

JOINT I.A.S./C.A.I. MEETING

Chateau Laurier, Ottawa

AVIATION IN THE POLAR REGIONS

October 23rd Morning 9.00 a.m.

OPERATION OF AIRCRAFT

Chairman
P. J. Lyons
DEWLine Co-ordinator, TransAir Ltd.

Problems Associated with Trans-Polar Airline Operations
A. L. Bingham, Operations Engineer, and
I. A. Gray, Director of Maintenance and Engineering,
Canadian Pacific Air Lines, Ltd.

Flight Testing the C-130BL Hercules in the Antarctic
H. B. Dees, Engineering Test Pilot, and
P. D. Gillich, Flight Test Engineering,
Lockheed Aircraft Corp., Georgia Division

The Use of Helicopter Support in Polar Operations
W. C. E. Loftus, Operations Manager, Helicopters, and
LCDR J. P. Croal, Special Projects Manager,
Spartan Air Services Ltd.

October 23rd Afternoon 2.00 p.m.

POLAR NAVIGATION

Chairman
E. C. Kendall
Chief Navigator, Canadian Pacific Air Lines, Ltd.

Transpolar Jet Navigation
E. S. Pedersen, Chief Navigator,
Scandinavian Airlines System

Naval Aviation in Antarctica
Capt. W. H. Munson, USN Ret'd.

Integrated Navigation Systems for V/STOL Aircraft
A. W. Duguid, Manager, Navigation Systems
Engineering Branch, Computing Devices of Canada Ltd.

October 23rd Evening 7.00 p.m.

DINNER

Chairman
A/C W. P. Gouin
President, Canadian Aeronautical Institute
Principal Speaker
Dr. James E. Mooney
Deputy US Antarctic Projects Officer

October 24th Morning 9.00 a.m.

SEARCH AND RESCUE

Chairman
W/C W. C. Klassen
Director of Transport and Rescue Operations, RCAF
Panel Discussion by the following Members

J. G. Brindle	Dept. of Transport, Canada
R. Fulton	Consultant, USA
R. A. Houghton	Grumman Aircraft Engineering Corp.
S/L S. E. M. Milliken	RCAF
Col. T. L. Shockley	USAF

October 24th Afternoon 2.00 p.m.

ENGINEERING CONSIDERATIONS

Chairman
F. C. Phillips
Director of Research and Development, Canadair Ltd.

Considerations for Landing Aircraft on Floating Ice
T. G. Dunkin, Operations Engineering Manager,
Canadair Ltd.

Aircraft Maintenance in Polar Regions
P. Hartline, Director Ground Equipment,
Trans World Airlines

Some Aspects of Cold Weather Testing and Operation of Aircraft
F/L K. Weinstein, Project Engineer, Climatic Testing,
Central Experimental and Proving Establishment, RCAF

ANNUAL GENERAL MEETING

THE 1961 Annual General Meeting of the Institute was held in the Royal York, Toronto, on the 25th and 26th May. The total registration was 187 and the attendance at the various sessions was generally of the order of 80.

ANNUAL GENERAL MEETING

The programme started with the business session, the Annual General Meeting proper, with the President, Mr. David Boyd, in the Chair. After Mr. C. H. Bottoms, the Chairman of the Toronto Branch, had said a few words of welcome, the proceedings began with the presentation of the Reports of the Admissions, Publications, Programmes and Planning Committees followed by the presentation of the Annual Report of the Council by the President. The President explained that the duties of the Finance Committee had been assumed by the Executive Committee of the Council and, in fact, a great deal of his Report dealt with the financial situation. For the second consecutive year the Institute had suffered a heavy financial loss, due in the main to increased costs of publication of the Journal and a sharp falling off in advertising revenue. The President outlined the steps that had been taken and those recommended to the incoming Council to enable the Institute to live within its means; these entailed a reduction in the size of the Journal, a reduction in staff and the temporary discontinuation of the Mid-season Meeting. A summary of the Council's Report and the Financial Statement appear on pages 280 to 283 and the full text of the Report is available on request.

Immediately after the transfer of the President's Badge by the retiring President, Mr. David Boyd, to his successor, A/C W. P. Gouin, at the Annual Dinner. Mr. B. S. Shenstone, the Principal Speaker, is on the left.

SECTION ANNUAL GENERAL MEETINGS

After the Institute's business session the technical sessions began and, concurrently with two of them, the Specialist Sections held their Annual General Meetings.

Astronautics Section

The first of these was the business session of the Astronautics Section, which opened with Professor G. S. Glinski, the retiring Vice-Chairman, giving a brief Annual Report prepared by Dr. P. M. Millman, who was unable to attend. There was some discussion among the small gathering in reviewing the work of the past year, and then the names of the incoming Executive Committee were announced and Professor I. I. Glass took over the Chair. Professor Glass described the plans already well advanced for a two-day symposium, to be held in Toronto in the fall.

Test Pilots

The business session of the Test Pilots Section was held in the morning of the second day. Copies of the Annual Report were circulated and Mr. R. J. Baker, the retiring Chairman, read it to the meeting, enlarging on some of the points. W/C R. J. Christie, the Chairman for 1961-62, took over the proceedings after the names of the incoming Executive Committee had been announced and there was some spirited discussion on a number of subjects, notably on a proposal that the scope and membership of the Section should be expanded. The Test Pilots, too, plan to hold a two-day meeting in the fall and this was discussed briefly.

Propulsion

The business session of the Propulsion Section, which followed the Test Pilots', was less formal than the other two and the attendance was disappointing. Mr. J. J. Eden, the retiring Chairman, presided. Dr. E. P. Cockshutt, the Secretary for 1961-62, was the only member of the new Executive Committee present. This Section had had some difficulty getting into its stride, but, during the past year, an encouraging start had been made by the Montreal Propulsion Group. Plans for the future development of the Section were considered.

HONOURS AND AWARDS

The session devoted to Honours and Awards was held in the afternoon of Thursday, the 25th May, with Mr. David Boyd presiding. He began by announcing that no Honorary Fellows had been appointed this year and, turning to the McCurdy Award, the premier award, he expressed his sincere regret at Mr. McCurdy's absence; in the past this Award had always been presented by Mr. McCurdy in person but, this year, a message had been received saying that he was ill in hospital and could not attend. On behalf of the meeting, the President wished him a speedy recovery.

He then announced the winner of the McCurdy Award as Mr. J. T. Dyment and, after the Secretary had read the citation, the President presented the Award. Mr. Dyment acknowledged it with a short address.

The President then announced the winning paper for the F. W. (Casey) Baldwin Award. This was a paper entitled "The Fan-in-Wing Powerplant System for VTOL Aircraft" by Dr. E. P. Cockshutt and Mr. N.

The F. W. (Casey) Baldwin Award: the President presenting the Medal to Dr. E. P. Cockshutt. Mr. N. Galitzine, the co-author of the prize-winning paper, was unfortunately not present to receive his award in person.

The W. Rupert Turnbull Lecturer, Mr. J. C. M. Frost (r) receiving the scroll from the President.

Galitzine, published in the November 1960 issue of the Journal. He called on Dr. Cockshutt and presented the silver medal to him. Mr. Galitzine was unable to be present and the President asked the Secretary to send his medal to him by mail.

Finally the President introduced Mr. J. C. M. Frost, of Avro Aircraft, who had been selected to deliver the W. Rupert Turnbull Lecture, and he briefly reviewed the history and accomplishments of Dr. Turnbull, in whose memory the Lecture is annually presented. Mr. Frost's Lecture was entitled "The Canadian Contribution to the Ground Cushion Story" and outlined in detail the development of the Avrocar. (The Lecture will be published in full in a later issue of the Journal.) At its conclusion, Mr. Frost showed an excellent film depicting various features of its test and development programme and scenes of the Avrocar in flight.

THE DINNER

There were 283 present at the Annual Dinner, held in the Concert Hall on the 25th May. After his introduction of the Head Table, which included the winners of the Institute's awards, Chairmen of the technical sessions, members of the Council and representatives of the major Sustaining Members in the Toronto area, the President read the following exchange of cables between himself and the Institute's Patron, H.R.H. the Prince Philip.

> "The Annual General Meeting of the Canadian Aeronautical Institute will take place on the 25th and 26th May in Toronto with the Annual Dinner on the Thursday evening. It will be held in the Royal York where we had the pleasure of meeting your Royal Highness at the Engineers Luncheon in June 1959 and we shall remember that happy occasion. I am sure that I speak for the Council and members of the Institute in expressing our appreciation of your continued interest in our activities and in sending you, as our most distinguished Patron, our greetings at the conclusion of another year.
>
> David Boyd, President"

> "Thank you for your kind message. I hope you have a successful Annual General Meeting and a very good Dinner on Thursday 25th.
>
> Philip, Patron"

He also read a cable from the Secretary of the Royal Aeronautical Society:

> "The President and Council send you greetings and best wishes on the occasion of your deliberations and your Annual General Meeting. They hope that the "youngster" will go from strength to strength and look forward to meeting you in London in September at the Aeronautical Conference.
>
> Ballantyne"

These messages of good wishes were very cordially received.

The President then introduced the Guest of Honour and Principal Speaker, Mr. B. S. Shenstone, Chief Engineer of British European Airways, reminding the audience that he was the first graduate of Professor Loudon's Aeronautical Engineering course at the University of Toronto and graciously calling on Professor Loudon to take a bow. Mr. Shenstone received a standing ovation. His address, to which he gave the provocative title "The World's Most Dangerous Airline", was directed against the premature adoption of supersonic transports and appears on pages 259 and 260 of this issue. Mr. J. T. Dyment was called upon by the President to propose a vote of thanks.

Traditionally the Annual Dinner is the setting for the transfer of the Presidency, and the President introduced his successor, A/C W. P. Gouin, in French — with a translation. He then transferred the chain of office; and A/C Gouin acknowledged it in French. Before adjourning the Dinner, the new President referred briefly to the difficulties that lay ahead and appealed for the membership's full support.

TECHNICAL SESSIONS

There were three technical sessions in the programme, held in the morning of the first day and in the morning and afternoon of the second.

Ground Effect Vehicles

This session followed the Institute's Business meeting and consisted of the presentation of two excellent papers entitled "On the Aerodynamics of Curved Jet Sheets" and "Control Systems for Ground Effect Machines" by Dr. K. G. Korbacher of the UTIA and Mr. T. D. Earl of Avro Aircraft, respectively. Professor B. Etkin was in the Chair during this session. It was attended by about 90 people, but there was little discussion.



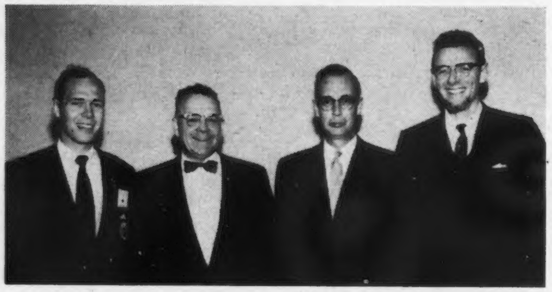
Ground Effect Vehicles Session: (l to r) Dr. G. K. Korbacher, Professor B. Etkin (Chairman) and Mr. T. D. Earl.

Aerodynamics of VTOL/STOL and Helicopters

There was also a good attendance for the second of the technical sessions, held under the Chairmanship of Mr. F. H. Buller of De Havilland Aircraft of Canada. The three papers presented were "Aerodynamic Testing of VTOL/STOL Models Using a Mobile Test Rig" by Mr. O. E. Michaelsen of Canadair, "Running Takeoff Overload Limitations of Some VTOL Aircraft" by Mr. K. Korsak of Piasecki Aircraft and "Test on a Model Fan-in-Wing for VTOL aircraft" by Mr. H. S. Fowler of the NRC. Mr. Michaelsen's paper was rather longer than expected and threw the session somewhat behind schedule but, in other respects, it was a very satisfactory and well-balanced group.

Man-powered Flight

The final session of the Meeting was opened by Dr. M. G. Whillans, Chairman of the Man-powered Flight Committee, who gave a report on the work of this Committee during the past year and then introduced Mr. H. Haessler, one of the great pioneers of man-powered flight, who was present in the room. He also expressed his regret that Mr. Enea Bossi, another of the great pioneers, was under doctor's orders and unable to come as he had hoped to do. He then handed the meeting over to Mr. R. J. Templin, Moderator of a Panel comprising Mr. B. S. Shenstone of BEA, Dr. J. G. Fletcher of the DRML, Professor H. E. T. North of the University of Maintoba, Mr. R. D. Hiscocks of De Havilland Aircraft of Canada and Professor O. Cochkanoff of the Nova Scotia Technical College. This Panel reviewed various aspects of the subject and Professor Loudon and Mr. Haessler contributed some prepared observations. An interested discussion from the floor ensued. This developed into a general consultation by Mr. H. C. Luttman, Secretary CAI, on what the future activities and objectives of the Institute in this field should be.



Aerodynamics of VTOL/STOL and Helicopters Session: (l to r) Mr. O. E. Michaelsen, Mr. K. Korsak, Mr. F. H. Buller (Chairman) and Mr. H. S. Fowler.

Finally Dr. J. J. Green, Vice-President, said a few words to close this session and adjourn the Annual General Meeting of 1961.

Man-Powered Flight Panel: (l to r) Dr. J. F. Fletcher, Professor O. Cochkanoff, Mr. B. S. Shenstone, Mr. R. J. Templin (Moderator), Mr. H. Haessler, Mr. R. D. Hiscocks and Professor H. E. T. North.

THE McCURDY AWARD - 1960

Mr. J. T. Dyment (r) receiving the McCurdy Award and Medal from the President.

THE presentation of the McCurdy Award for 1960 took place at the Honours and Awards Session of the Institute's Annual General Meeting. Unfortunately Mr. McCurdy was prevented from being present as in former years, and the Award was presented to Mr. J. T. Dyment, Chief Engineer, Trans-Canada Air Lines, by the President, Mr. David Boyd.

The Citation reads as follows:

As everybody knows, John T. Dyment is the Chief Engineer of Trans-Canada Air Lines and, to judge by the record of that airline, he has done his job superlatively well. It is perhaps not so well known, in Canada at any rate, that he has found time to establish himself as a world figure in the field of international air transport and, springing from the first, this second career is almost the more significant.

Mr. Dyment was born in Barrie, Ontario, and educated at St. Andrews College and the University of Toronto, whence he graduated in Mechanical Engineering in 1929. An early indication of his mettle came in the award of the Sword of Honour as the top-ranking cadet in the RCAF flying training course at Camp Borden in 1927.

On graduation he served for a year and a half in the Airplane Division of the Ford Engineering Laboratories. He then transferred to the Department of National Defence, as a stress analyst, and, when the Department of Transport was created, became Assistant Aeronautical Engineer. He joined Trans-Canada Air Lines as Chief Engineer in 1938; and thereafter his story has been synonymous with the history of TCA.

In 1938 the TCA fleet consisted of a few Lockheed 14's and Electras. Time passed and so did the Electras. More 14's and Lodestars came and went. In 1943, Lancastrians were put on the trans-Atlantic route and the great era of TCA's trans-ocean operations began. DC-3's and North Stars replaced the Lockheeds soon after the war and the Super-Constellations were introduced in February 1954. In December 1954, the great Viscount appeared on the TCA domestic routes, the first turboprop airliner in regular service in North America. Last year the DC-8 and this year the Vanguard completed the all-turbine fleet.

The technical development of the TCA fleet, through the years since 1938, has been directly guided by Mr. Dyment's engineering insight and judgment. Concurrently he has built up the TCA engineering organization, methods and facilities to a point where the airline is now not only one of the largest but certainly one of the safest and most reliable in the world.

To most men this would have been achievement enough but Mr. Dyment has taken a very active part in the development of air transport on a worldwide scale. He has been a member of several IATA Committees and has participated vigorously in the regulatory work of ICAO. He has exerted a constant and often unobstrusive influence in a consulting capacity on many trends of aeronautical, and particularly airline, engineering. His interest in human engineering and cockpit design, his authority on cold weather operations, his imaginative engineering concepts, as exemplified in the installation of British engines in American airframes to evolve the North Star, and his far-sighted advocacy of the turbine-powered transport – all these are contributions that he has made to air transport far beyond the bounds of TCA.

Besides being very active in the work of the Society of Automotive Engineers, of which he is a Director, he is a Fellow of the Royal Aeronautical Society and of this Institute; he has thus taken his place in three leading professional bodies of the USA, Great Britain and Canada.

Such is the man whom the Institute would honour today. For such a sustained record of engineering achievement, culminating in the fulfilment of his turbine trinity – the Viscount, the Vanguard and the DC-8 – Mr. Dyment has fully merited the premier award in the technical fields of Canadian aviation, the McCurdy Award.

SUMMARY OF THE ANNUAL REPORTS

Of the Council and its Committees

1960-1961

IT HAS been a year of contrasts, with increased activity in almost every field on the one hand and, on the other, a sharply deteriorating financial situation.

FINANCE

Finance has been the dominant problem facing the Council and, to maintain a closer control, it became necessary to transfer the duties of the Finance Committee to the Executive Committee of the Council during the course of the year. Furthermore the Planning Committee was instructed to make a reappraisal of the whole structure and aims of the Institute, and to recommend both short- and long-term measures to effect economies and increase the Institute's income; several of their proposals have been adopted.

The Council started the year with a deficit budget and hoped to be able to recover its balance, figuratively speaking, during its term of office. Unfortunately the final result shows a deficit of about double that budgeted for; the figures are Total Income $52,970, Total Expenditure $67,090, leaving a loss of $14,939 on the year's operations. The set-back has been due almost entirely to increased publication costs of the Journal and a simultaneous falling-off of advertising since December.

In an attempt to broaden the basis of the Institute's financial support, the Council, with the active cooperation of the Branches, has been trying to increase Sustaining Membership – and it has met with some success. But we cannot rely on this alone and it is hoped that the following measures will further alleviate the situation during the coming year:

(i) A reduction in the size of the Journal.

(ii) The publication of certain papers for the National Research Council, for a fee.

(iii) The further sub-letting of Headquarters office space.

(iv) An appeal, addressed to all members, asking them to add a little extra when paying their dues this year.

(v) An appeal to Sustaining Members asking them to increase their contributions by 10%.

(vi) A further reduction of the already inadequate staff; Mr. Chisholm, the Assistant Secretary, will leave at the end of May.

(vii) Discontinuation of the Mid-season Meeting, to reduce the general load on Headquarters.

Some of these measures have already been introduced and others will be recommended to the incoming Council. It seems possible to produce an effectively balanced budget by this means but whether the reduced staff will be able to carry the additional burden remains to be seen.

PERFORMANCE

Despite the financial difficulties the Institute's services have been maintained and even increased. Perhaps most significant of all, the downward trend in the membership, which started in 1959 and might have been expected to continue for several years, has been checked. In March 1959 the membership was 2,281, in March 1960, 2,084, and in March 1961, 2,051. Detail figures are of interest: in 1959-60 the total loss of members was 390 and the intake 193, leaving a net loss of 197; in 1960-61 the total loss was 292 and the intake 259, leaving a net loss of 33.

The Institute held its usual three two-day meetings, namely the Joint IAS/CAI Meeting in October, the Mid-season Meeting in February and this Annual General Meeting. In addition the Astronautics Section and the Test Pilots Section held very successful two-day symposia – this was a new feature of the over-all programme. And all the Branches, with the exception of Cold Lake, which has suffered due to its peculiar dependence on the military programme, have held full series of meetings throughout the season; five tour speakers were arranged by the National Programmes Committee and the President visited all the Branches during the year, save Halifax-Dartmouth and Quebec, which were visited by the Secretary alone.

The Journal has been bigger and the ten issues have carried material equivalent to thirteen issues of the size of those of 1959-60. Moreover the Journal is becoming known and respected and the supply of material submitted for publication is no longer a source of worry. It is most unfortunate that, at this stage in its development, it appears necessary to reduce its content for lack of advertising.

On the international scene, the Institute took part in the Second International Congress in the Aeronautical Sciences in Zurich last September; three Canadian papers were included in the programme and a delegation of 9 attended from this country. In addition several members of the Institute attended the International Congress and Exposition of the SAE in Detroit and the Secretary represented the Institute as its official delegate.

The Institute will be taking part in the Eighth Anglo-American Aeronautical Conference in London in September 1961.

ELECTION OF FELLOWS

The procedure for the election of Fellows, which was revised in 1959-60 to provide for an initial screening of nominations by a Committee of Fellows, before submission of the Committee's recommendations to the Council, is a very searching and thorough and, it is believed, just system. It is a pleasure to announce the Fellows elected this year as follows:

J. A. Chamberlin
A/V/M J. A. Easton
Professor I. I. Glass
T. A. Harvie
D. N. Kendall
B. K. O. Lundberg
R. J. Moffett
R. J. Templin
Dr. M. G. Whillans
W/C J. G. Wright

NEW COUNCIL

The President and Vice-President for 1961-62 were elected by the Council at the meeting in Winnipeg in February. They are

President A/C W. P. Gouin
Vice-President Dr. J. J. Green

The other members of the incoming Council are

Mr. D. Boyd (Past President)
Mr. G. F. W. McCaffrey
Dr. J. H. T. Wade
Mr. E. H. Higgins
Mr. D. R. Taylor
Mr. R. J. McWilliams
Mr. J. G. Davidson
Mr. A. J. Robinson
Mr. R. Wallworth
Mr. W. E. Jamison

COMMITTEES

The reports of the Committees are summarized as follows:

Admissions

The Committee met 13 times, and the admissions and regradings granted were as follows — last year's figures are shown in brackets:

	Admissions		*Regradings*	
Associate Fellow	13	(8)	7	(11)
Member	80	(45)	24	(16)
Associate	14	(4)	1	(0)
Technical Member	75	(32)	27	(7)
Junior Member	3	(2)	2	(5)
Students	87	(87)	0	(0)

In addition an important feature of the Committee's work was the consideration given to the recognition of piloting as experience in "operational work" — to quote from the Bylaws — and the submission of a recommendation thereon to the Council. The Council adopted the recommendation and established the policy that full credit should be given for experience as a professional pilot. This ruling should remove many anomalies which have affected the grading of applicants in the past.

Publications

The material submitted for publication has increased rapidly during the year, placing the Editor and the Editorial Board in a fairly comfortable position in this respect, but the sale of advertising space fell sharply after December to a dangerously low level.

In an attempt to economize, certain features of the Journal were discontinued in the April issue, the frontispiece and editorial were dropped and the CAI Log condensed considerably. Further economies can be effected only by reduction of the frequency of issue or of the technical content of each issue and, on balance, the latter seems to be the preferable course.

On a suggestion from the Planning Committee, two innovations were introduced during the year, namely index cards and the arrangement of the publication so that any one paper could be extracted and filed without interfering with its neighbours. This device was supported by the provision of three holes, for a standard ring binder, punched right through the whole publication. As a further development of this scheme to make the Journal as a whole more useful to its readers, advertisers were encouraged to adopt what was called "catalogue advertising", whereby succeeding advertisements would be designed to be extracted and filed cumulatively, to produce a useful body of reference information. This scheme has not yet caught on but it is believed to have considerable possibilities.

National Programmes

The Committee has been occupied during the year with the plans for the Mid-season Meeting, this Annual General Meeting and the IAS/CAI Meeting to be held next October, the arrangement of tour speakers and a study of the reasons underlying the rather disappointing attendance at all meetings, at both Institute and Branch levels.

On this last point, no real answer has been found. An attempt has been made to plan each Institute meeting around a central theme so that people within the broad group of interest will find something useful in all the sessions and so more readily justify the cost and trouble of attending. This seems to be producing results, but it is not the complete answer. So far as Branch meetings are concerned, poor attendance is particularly distressing when tour speakers have been arranged and have gone to considerable trouble and expense to visit the Branches. We can only suggest that the Branches themselves do everything in their power to arouse interest and enthusiasm for the work of the Institute among their members.

Planning

The work of the Committee has fallen into two categories, consideration of the present emergency and the suggestion of measures to improve the services of the Institute to combat it, and consideration of long-term policy and the recommendation of developments that appear to be desirable. In the first category the "dismantleability" of the Journal and the introduction of catalogue advertising were suggested to the Publications Committee and subsequently adopted. Furthermore negotiations with the NRC and DOT resulted in an arrangement (listed as Contracts in the financial statement) whereby the Institute should publish selected NRC papers and DOT notices for a fee.

In the long term the Committee recommends strongly that every effort should be made to increase membership, with particular attention to the astronautical fraternity. In addition every opportunity should be taken to improve the Journal to the point where it is recognized and accepted as the forum for Canadian aeronautical work in science and engineering. Consideration was also given to the improvement of meetings, the development of a Code of Practice and cooperation with other Canadian engineering societies. Recommendations on these points were submitted to the Council and the Committees concerned.

AUDITORS' REPORT

To the Members,
Canadian Aeronautical Institute,
Ottawa, Ontario.

We have examined the balance sheet of the Canadian Aeronautical Institute as at March 31, 1961, and the statements of revenue and expenses for the year ended on that date. Our examination included a general review of the accounting procedures and such tests of the accounting records and other supporting evidence as we considered necessary in the circumstances.

In our opinion the accompanying balance sheet and statements of revenue and expenses present fairly the financial position of the Institute as at March 31, 1961, and the results of its operations for the year ended on that date, in accordance with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

ARMSTRONG, CROSS & CO.,
Chartered Accountants.

OTTAWA, Ontario,
April 24, 1961.

Statement 1

CANADIAN AERONAUTICAL INSTITUTE

BALANCE SHEET

(Exclusive of Specified Funds)

As at March 31, 1961

ASSETS

Current:			
Cash on hand and in bank	$10,575.54		
Less: Due to Specified Funds	339.53		
		$10,236.01	
Accounts receivable		744.15	
Hydro Electric Power Commission bonds, 3½% due March 1, 1977 — at cost		11,970.00	
Accrued bond interest		104.06	
Prepaid medical and surgical premiums		73.67	
			$23,127.89
Fixed — at cost:			
Furniture and fixtures		4,491.83	
Less: Accumulated depreciation		2,781.01	
			1,710.82
			$24,838.71

LIABILITIES AND SURPLUS

Liabilities:		
Accounts payable and accrued charges	$ 2,696.65	
Fees received in advance	9,144.50	
Journal subscriptions received in advance	676.00	
		$12,517.15
Surplus:		
Balance — March 31, 1960	27,260.66	
Less: Net loss for the year — per Statement 2	14,939.10	
		12,321.56
		$24,838.71

Statement 2

CANADIAN AERONAUTICAL INSTITUTE

STATEMENT OF REVENUE

For the year ended March 31, 1961

Meetings		$ 6,226.45
Publications:		
Journal subscriptions	$ 5,131.02	
Advertising	7,681.06	
List of Members	907.88	
Sundry technical papers	1,801.20	
Contracts	320.00	
		15,841.16
Membership:		
Members' dues	14,191.00	
Entrance fees	580.00	
Sustaining members	14,800.00	
		29,571.00
Investment:		
Bond interest — Hydro Electric Power Commission — 3½%	420.00	
Bank interest	329.49	
		749.49
Miscellaneous:		
Office supplies	45.79	
Lapel pins, Christmas cards and blazer crests	186.21	
Sub rental — Office space	350.00	
		582.00
Total Revenue		52,970.10
Total Expenses — from Statement 3		67,909.20
Net Loss For The Year		$14,939.10

Statement 3

CANADIAN AERONAUTICAL INSTITUTE

STATEMENT OF EXPENSES

For the year ended March 31, 1961

MEETINGS:		
Dinners and facilities	$ 4,942.82	
Printing	788.75	
Staff travel	404.12	
Section meetings	503.06	
		$ 6,638.75
PUBLICATIONS:		
Journal	20,883.66	
Sundry technical papers	1,362.28	
List of Members	1,888.95	
Salaries and Headquarters expenses	9,875.55	
		34,010.44
REMISSION TO BRANCHES AND SECTIONS:		
Standard allowances	1,709.97	
Special allowances	103.54	
		1,813.51
MEMBERSHIP ROUTINE		240.03
SECRETARIAT:		
Salaries	16,041.74	
Staff benefits	828.64	
		16,870.38
HEADQUARTERS:		
Rent	3,546.69	
Insurance	23.23	
Telephone and telegraph	550.47	
General maintenance	48.00	
Office supplies	2,376.36	
Exchange and bank charges	198.35	
Legal and audit fees	252.00	
Miscellaneous	195.03	
Travel	696.78	
		7,886.91
CAPITAL EQUIPMENT:		
Provision for depreciation		449.18
Total Expenses — to Statement 2		$67,909.20

Statement 4

CANADIAN AERONAUTICAL INSTITUTE

STATEMENT OF SPECIFIED FUNDS

For the year ended March 31, 1961

SCHOLARSHIP FUND:		
Balance — March 31, 1960	$19,297.99	
Interest earned	714.11	
		$20,012.10
AWARD FUND:		
Balance — March 31, 1960	1,570.29	
Interest earned	178.53	
	1,748.82	
Less: Expended	398.37	
		1,350.45
		$21,362.55
REPRESENTED BY:		
Cash on deposit	$ 2,766.15	
Dominion of Canada bonds — 4¼% 1972 (par $19,500.00) — at cost	18,256.87	
		$21,023.02
Due from General Fund		339.53
		$21,362.55

SYMPOSIUM — INTERPLANETARY EXPLORATIONS

at the

INSTITUTE OF AEROPHYSICS, UNIVERSITY OF TORONTO

SPONSORS

C.A.I.: Astronautics Section—Canadian Astronautical Society—David Dunlap Observatory—Institute of Aerophysics

26th October Morning 9.30 a.m.

INTRODUCTORY REMARKS
Dr. G. N. Patterson
Director, Institute of Aerophysics

TERRESTRIAL SPACE I
Chairman
Dr. D. C. Rose
Chairman, N.R.C. Associate Committee on Space Research
On the Determination of the Earth's Atmospheric Structure with Sounding Rockets and Artificial Satellites
Professor V. C. Liu
Dept. of Aeronautical and Astronautical Engineering, University of Michigan
The Entry of Manned Manoeuvrable Spacecraft into Planetary Atmospheres
Prof. B. Etkin
Institute of Aerophysics, University of Toronto

October 26th Afternoon 1.00 p.m.

LUNCHEON
Chairman
Dr. J. J. Green
Chief Superintendent, Canadian Armament Research & Development Establishment
Speaker
Dr. W. R. Franks
Professor, Banting & Best Dept. of Medical Research, University of Toronto
God's Image and Space Travel

October 26th Afternoon 2.30 p.m.

TERRESTRIAL SPACE II
Chairman
Dr. P. A. Lapp
Chairman, Canadian Astronautical Society
The Canadian Topside Sounder Satellite
Dr. J. H. Chapman
Deputy Chief Superintendent,
Defence Research Telecommunications Establishment
Structural and Thermal Design of the Topside Sounder Satellite
H. R. Warren
Chief of Mechanical Develop., Special Products Div.,
De Havilland Aircraft of Canada Ltd.
and
John Mar
Satellite Design Section,
Defence Research Telecommunications Establishment

October 27th Morning 9.30 a.m.

LUNAR SPACE
Chairman
Dr. J. F. Heard
Director, David Dunlap Observatory
Current Interpretations of the Lunar Topography
Dr. D. A. MacRae
Professor of Astronomy, University of Toronto
The NASA Program for Unmanned Exploration of the Moon
B. Milwitzky,
Head, Lunar Flight Systems, NASA Headquarters

October 27th Afternoon 1.00 p.m.

LUNCHEON
Chairman
F. R. Thurston
Director, National Aeronautical Establishment
Speaker
Dr. J. T. Wilson
Director, Institute of Earth Sciences,
University of Toronto
The World of the I.G.Y.

October 27th Afternoon 2.30 p.m.

PLANETARY SPACE
Chairman
Professor I. I. Glass
Chairman, Astronautics Section, C.A.I.
Atmosphere and Surface Conditions of Venus and Mars
Dr. J. A. Giordmaine
Bell Telephone Laboratories, Murray Hill
Scientific Investigation of the Regions Beyond the Moon
R. C. Moore
Head, Planetary Sciences,
National Aeronautics and Space Administration

October 26th Evening 7.00 p.m.

DINNER
Chairman
Dr. G. N. Patterson
Director, Institute of Aerophysics
Speaker
Dr. I. I. Glass
Professor of Aeronautical Engineering, Institute of Aerophysics
Aerophysical Research in Moscow

Bristol Aviation Representative briefs pilot on Bristol's facilities, gets service people "cracking" on servicing aircraft.

Bristol Aviation Services call on 100 years' experience to give pilots yeoman service and craftsman quality

Bristol Aviation Services live up to two famous names: Bristol Aeroplane and Shell. Both companies bring together a century of experience in the making, servicing and fuelling of aircraft throughout the world. This remarkable combination of talents makes for utmost reliability, versatility and technical know-how. And for a long tradition of service devoted to the safety and well-being of aircraft passengers.

BRISTOL AVIATION SERVICES opened their Dorval airport facilities last March 8th, under proud sponsorship. Bristol Aeroplane was founded in 1910 in England. Shell celebrates 51 years of close association with Canadian aviation and industry. This is a very practical assurance of reliability. Bristol Aviation Services are equipped to meet the most critical requirements, round the clock. Here is how.

Meet Mac Nelthorpe

Bristol Aviation's warm personality is the friendly smile of Mac Nelthorpe, on hand to greet you as your plane comes to a stop. Mac is no mere handshake man—knows what's up in the cockpit and what Bristol can do for you, routine style or in the thick of emergencies. He'll outline to you the complete range of Bristol's services. Here they are, capsule fashion.

What Bristol can do for you

Bristol Aviation Services cover the full range of aircraft handling, maintenance and refuelling facilities. Ramp handling, heating and de-icing, towing, are part of our regular services. Repair, overhaul and maintenance are done in Bristol's modern shops equipped to handle any craft, from commercial jets to single-seaters.

Bristol does not stress frills at the expense of essential technical requirements. Our lounge, restaurant, private aircraft and car park, our reservation facilities are efficient without being needlessly flamboyant. Our main concern remains with the prime responsibility of the aircraft pilot: the safety and well-being of his passengers.

NOTE TO U.S. PILOTS: Bristol Aviation Services are located in the customs office building. You get speedy clearance with a minimum of fuss.

How Shell Helps

Shell's laboratories are at the forefront of aviation research. Outstanding instance of this well-established superiority is AeroShell Oil W. This remarkable lubricant brings easier starting, faster warm-up and reduced engine wear to all types of piston aircraft.

Your engine runs more efficiently, parts last longer, thereby reducing maintenance costs.

Bristol Aviation Services have the sign of the Shell for happy landings and safe take-offs.

SHELL

T-AV-161

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